

Table 3-8. Algal Bioassay Summary

Algal Bioassay Endpoint (Day 8) Biomass Summary*				
Treatment Group	Biomass Parameters			
	Cell Density Mean cells/mL	Dry Weight Mean mg/L	Chlorophyll- a Mean µg/L	
<i>Selenastrum capricornutum</i>				
A S3500 Sample: Lake Michigan reference water outside effluent dispersion zone	31,667	2.3	1.1	
B S340 Sample: Estimated 40:1 dilution inside effluent dispersion zone	8,333	1.2	2.3	
C S120 Sample: Estimated 20:1 dilution inside effluent dispersion zone	11,667	3.2	2.7	
D 95% S3500 water and 5% Effluent (20:1) dilution	3,333	1.4	0.9	
E 97.5% S3500 water and 2.5% Effluent (40:1) dilution	5,000	1.2	0.6	
F Lab Controls: Filtered and unfiltered algal growth medium	6,525,000	88.2	66.4	
<i>Scenedesmus quadricauda</i>				
A S3500 Sample: Lake Michigan reference water outside effluent dispersion zone	11,667	36.9	14.1	
B S340 Sample: Estimated 40:1 dilution inside effluent dispersion zone	10,000	35.1	11.0	
C S120 Sample: Estimated 20:1 dilution inside effluent dispersion zone	13,333	34.3	10.1	
D 95% S3500 water and 5% Effluent (20:1) dilution	15,000	35.0	17.3	
E 97.5% S3500 water and 2.5% Effluent (40:1) dilution	6,667	33.4	16.8	
F Lab Controls: Filtered and unfiltered algal growth medium	1,050,000	207.1	104.6	

Biological data are means of three replicate exposures.

b USEPA control algal medium for *Selenastrum* toxicity tests (ESEPA 600/4-89/001).

Data were transformed as:

$$X' = \log (X + 1)$$

The transformed data met the normality test, but did not meet the homogeneity test. Consequently, non-parametric comparisons were used for the *Selenastrum* dry weight data. Treatment F was a performance control to demonstrate that the algae were viable and met quality control expectations; growth in the algal growth medium was satisfactory. Treatment F was not included in statistical comparisons of the field samples.

The ANOVA test of *Scenedesmus* data indicated no effect of treatments. This was confirmed by comparisons of individual treatments using Dunnett's test. The *Selenastrum* data for chlorophyll-a was analyzed the same way and with the same results: no differences between treatments.

To analyze the *Selenastrum* dry weight data, the Wilcoxon Rank Sum test with a Bonferroni adjustment was used. This test indicated no significant differences between any treatment groups. (Although, Steel's Many-One Rank test is recommended by USEPA (1989) for similar data, insufficient replicates were available to conduct this test).

The second goal of the algal bioassays was to determine if diluted effluent would cause any significant algal effects, using 20:1 and 40:1 dilutions. Student's t-test was used to compare algal dry weight and chlorophyll-a results of Treatments B with E, and C with D. Results indicated no statistically significant differences for *Scenedesmus* data. No statistically significant results were found for *Selenastrum* except for mean chlorophyll-a values between Treatment C and D. The chlorophyll-a from Treatment C (sample taken from S120) was higher than in Treatment D (a mixture of 95% S3500 water and 5% treated effluent). The chlorophyll-a from Treatment D (0.9 $\mu\text{g/L}$) was very similar to that from Treatment A (100% S3500, 1.1 $\mu\text{g/L}$).

In conclusion, none of the treatments promoted algal growth relative to growth in the receiving water (S3500). Nutrient concentrations in some nearshore treatments (S120 and S340) were slightly elevated over background, but did not result in significant changes in algal growth. Algal growth was not impaired in mixtures of treated effluent and receiving water relative to growth in the unmixed receiving water, suggesting that the presence of 2.5 to 5% effluent would not have toxic effects on algal growth.

3.8 Water Chemistry

A summary of water chemistry data for samples collected April 23, 1994 is given in Table 3-9. Site S120 (120 ft from Outfall 001) is within the current discharge dispersion zone, and exhibited slightly higher concentrations of most parameters as compared to the other ambient stations. Comparison of ambient concentrations to effluent concentrations revealed immediate dispersion.

Chlorophyll-a concentrations were relatively low at all sites. Although the relationships between nutrient availability, zooplankton grazing, and phytoplankton productivity are dynamic, it is generally accepted that chlorophyll-a is a good indicator of phytoplankton biomass and lake trophic status. Chlorophyll-a concentrations are summarized in Table 3-10 and Figure 3-1. No clear pattern was shown between inside and outside the effluent dispersion zone. At all sites sampled, chlorophyll-a concentrations below 0.5 $\mu\text{g/L}$ were recorded. The lowest recorded reading of 0.24 $\mu\text{g/L}$ was recorded twice at S120 located within the effluent dispersion zone. The highest reading of 1.52 $\mu\text{g/L}$ was recorded at S2000, beyond the effluent dispersion zone. Phytoplankton densities observed in the biological samples were consistent with the observed range in chlorophyll-a values and conditions characteristic of mesotrophic lakes.

3.9 In-situ Water Quality

Table 3-11 presents in-situ water quality parameters measured during the April and May studies. All sites exhibited minimal stratification as temperature, D.O., and conductivity profiles were essentially uniform over the water column. The uniformity of these water quality parameters

TABLE 3-9 AMOCO BIOASSESSMENT - WATER CHEMISTRY ANALYSES

DATE	SAMPLE*	CHLORIDE (mg/L)	HARDNESS (mg/L)	TDS (mg/L)	TSS (mg/L)	TOC (mg/L)	NO3+NO2 (mg/L)	TOTAL NITROGEN (mg/L)	ORTHO PHOS (mg/L)	TOTAL PHOS (mg/L)	SILICA (mg/L)
21-Apr-94	S120A	22	147	220	1	3.5	0.45	0.58	1.03 <	0.04 <	0.04
21-Apr-94	S120B	22	146	228 <	1	5.9	0.45	0.68	1.13 <	0.04 <	0.04
23-Apr-94	S120A	21	144	192	2	4.4	0.49	0.55	1.04 <	0.04	0.07
23-Apr-94	S120B	21	141	192 <	1	2.9	0.47	0.66	1.13 <	0.04	0.11
23-Apr-94	S340A	15	140	168	2	2.7	0.43	0.26	0.69 <	0.04 <	0.04
23-Apr-94	S340B	16	142	190	4	4.1	0.45	0.12	0.57 <	0.04	0.06
23-Apr-94	S650A	16	143	172	2	3	0.44	0.34	0.78 <	0.04 <	0.04
23-Apr-94	S650B	15	143	158	1	4.3	0.45	0.3	0.75 <	0.04 <	0.04
23-Apr-94	S1000A	16	142	170 <	1	3	0.44	0.22	0.66 <	0.04 <	0.04
23-Apr-94	S1000B	17	141	162 <	1	3.7	0.44	0.24	0.68 <	0.04 <	0.04
23-Apr-94	EFFLUENT	149	205	675	3	8	1.76	0.82	2.58 <	0.04 <	0.04

*Samples collected for biomonitoring assessment screening purposes only.

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0.97

TABLE 3-10 AMOCO BIOASSESSMENT - CHLOROPHYLL-a ANALYSES

DATE	LAB	METHOD*	REPLICATE	CHLOROPHYLL-a (µg/L)					
				SITE S120	SITE S340	SITE S650	SITE S1000	SITE S2000	
23-Apr-94	LAB A	FLUOROMETRY	A	NA	NA	0.436	NA	--	
			B	0.241	0.379	0.470	0.476	--	
10-May-94	LAB A	FLUOROMETRY	A	NA	0.55	0.46	NA	0.37	
			B	0.64	0.42	0.49	0.54	NA	
10-May-94	LAB A	HPLC	C	0.37	0.70	0.43	0.71	NA	
			D	0.42	0.40	NA	0.73	0.43	
10-May-94	LAB B	SPECTROPHOTOMETRIC	A	0.246	0.353	0.403	0.439	NA	
			B	0.418	0.416	0.305	0.484	NA	
10-May-94	LAB B		A	0.714	0.571	0.814	1.110	0.460	
			B	0.958	0.640	0.429	1.260	0.608	
			C	0.745	0.436	0.656	1.040	0.630	
			D	0.509	0.683	0.650	1.520	0.447	
								--	

*Samples collected for biomonitoring assessment screening purposes only.

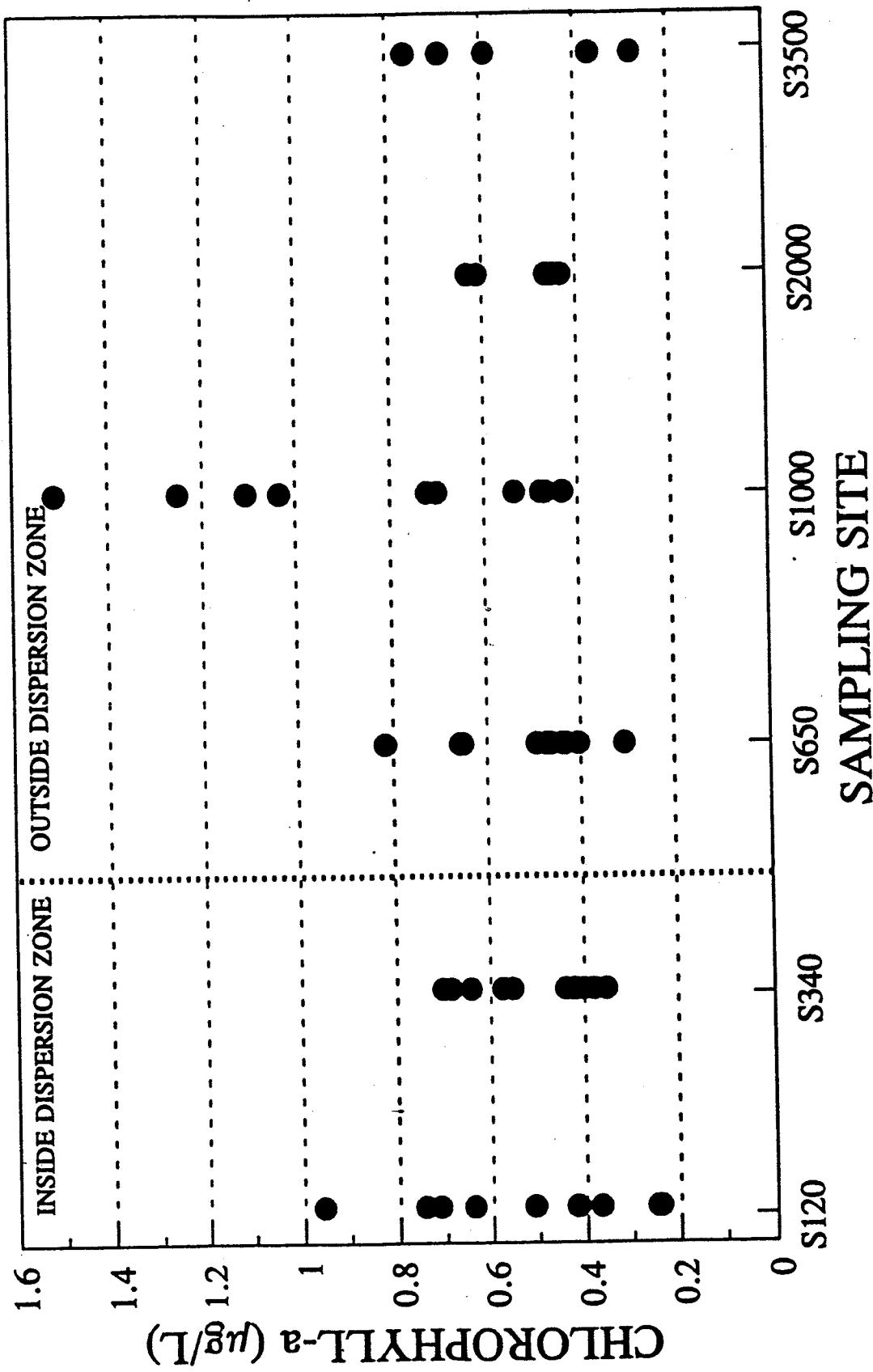
TABLE 3-11. AMOCO BIOASSESSMENT - WATER QUALITY DATA

STATION	DATE	TIME	DEPTH (m)	TEMP (°C)	DISSOLVED OXYGEN (mg/L)	pH (s.u.)	CONDUCTIVITY AT T °C (umhos/cm)	SECCHI DEPTH (m)	DISK	ALKALINITY REP A (mg/L)	ALKALINITY REP B (mg/L)
S120	04/20/94	1704	0	19.5		7.8		644			
			1	18.2		7.7		560			
			2.1	15.0		8.0		380			
S340	04/20/94		0	14.2		8.0		344			
			1.5	14.1		8.0		342			
			2.9	11.3		8.1		296			
S650	04/20/94	1607	0	14.5		8.0		355			
			1.5	14.7		8.0		355			
			3	11.2		8.1		295			
S1000	04/20/94	1624	0	16.2		8.0		378			
			1.5	15.6		8.0		370			
			2.9	11.0		8.1		293			
S120	04/21/94	1140	0	18.3		7.8		450	bottom		
			1.1	12.8		8.0		309			
			2.4	12.4		8.0		304			
S1000	04/21/94	1348	0	13.2		8.0		320	bottom		
			1.5	13.2		8.0		319			
			2.5	13.3		8.0		318			
S120	04/22/94	1600	0	13.8	10.3	7.9		316	bottom		
			1	13.7	10.3	7.9		315			
			2.1	13.5	10.3	7.9		312			
S120	04/22/94	1638	0	17.6	9.5	7.8		527	bottom		
			1	16.7	9.7	7.9		441			
			2.1	13.5	10.3	8.0		310			
S340	04/22/94	1722	0	14.9	10.0	8.0		324	bottom		
			1	9.9	8.0			326			
			2	14.6	10.0	8.0		320			
S650	04/22/94	1742	0	16.0	9.8	8.0		335	bottom		
			1	15.7	9.7	8.0		331			
			2	14.1	10.1	8.0		315			
S1000	04/22/94	1805	0	15.8	9.7	8.0		309	bottom		
			1	15.7	9.7	8.0		332			
			2	13.7	10.3	8.0		309			
S1000	04/22/94	1805	2.6	13.3	10.2	8.0		305			
			0	14.5	9.4	7.7		448	bottom	114.8	117.6
			1	12.8	10.0	7.8		372			
S340	04/23/94	1000	0	13.1	10.0	7.9		330	bottom	86.1	113.9
			1.3	11.6	10.0	7.9		306			
			2.6	9.8	11.5	8.0		281			
S650	04/23/94	1015	0	13.1	10.0	7.9		320	bottom	86.1	113.9
			1.6	9.8	10.5	8.0		280			
			2.9	9.8	10.7	8.0		281			
S1000	04/23/94	1027	0	11.9	10.1	7.9		306	bottom	104.0	109.9
			1.4	10.8	10.4	8.0		291			
			2.7	10.0	10.8	8.0		282			

TABLE 3-11. AMOCO BIOASSESSMENT - WATER QUALITY DATA

STATION	DATE	TIME	DEPTH (m)	TEMP (°C)	DISSOLVED OXYGEN (mg/L)	pH (s.u.)	CONDUCTIVITY AT T °C (umhos/cm)	SECCHI DEPTH (m)	DISK	ALKALINITY	ALKALINITY
										REP A (mg/L)	REP B (mg/L)
S120	05/10/94	1408	0	19.6	8.5	7.7		604	bottom		127.7
			0.5	17.8	8.8	7.7		523			
			0.9	15.1	9.4	7.8		411			
			1.4	13.9	10.0	8.0		296			
			1.8	13.6	10.0	8.0		296			
S340	05/10/94	1455	0	14.2	10.0	8.0		302	bottom		126.7
			0.9	14.2	9.9	8.0		304			
			1.4	14.2	10.0	8.0		303			
			1.9	13.9	10.0	8.0		295			
			2.5	13.7	10.3	8.0		297			
S650	05/10/94	1515	0	14.5	10.0	8.0		310	bottom		131.7
			0.5	14.4	9.9	8.0		309			
			1	14.4	10.0	8.0		307			
			1.5	14.4	10.0	8.0		307			
			2	14.3	10.0	8.0		305			
S1000	05/10/94	1552	0	15.2	9.8	8.0		321	bottom		143.6
			0.5	15.0	9.9	8.0		320			
			1	14.8	9.9	8.0		313			
			1.5	13.5	10.5	8.0		294			
			2	12.8	10.7	8.1		282			
S2000	05/10/94	1132	0	16.2	9.5	7.9		317	bottom		86.1
			1	16.1	9.5	7.9		316			
			2	12.5	10.2	8.0		288			
			3	12.2	10.3	8.0		285			
			4	12.1	10.3	8.0		284			
S3500	05/10/94	1030	5.3	12.1	10.4	8.0		284			
			1	11.9	10.3	8.0		285	6.3		94.1
			2	11.9	10.3	8.0		285			
			3	11.9	10.3	8.0		285			
			4	11.9	10.3	8.0		285			
			5	11.8	10.3	8.0		285			
			6	11.9	10.3	8.0		285			
			7	11.8	10.3	8.0		285			
			8.1	11.9	10.3	8.0		284			

FIGURE 3-1
CHLOROPHYLL-a CONCENTRATION
4-23-94 and 5-10-94



was indicative of rapid and complete dispersion. Generally higher conductivity at S120 indicated the presence of the mixed effluent plume. All Secchi disk readings were to bottom (total depth) except for S3500 where the Secchi disk depth was 6.31 meters (20.7 ft) and total depth at S3500 was 8.1 meters (26.5 ft). Total depth at all other sites ranged from 1.5 meters (S120) to 5.3 meters (S2000). On site observations showed that water clarity was reduced during high wind and wave action.

3.10 Effluent Water Quality

Figure 3-2 displays effluent temperature, pH and conductivity data obtained from the Hydrolab datalogger for May 12 to June 1, 1994. Effluent water quality was essentially constant during this portion of the study period. Elevated temperatures and conductivity variations confirmed a positively buoyant discharge.

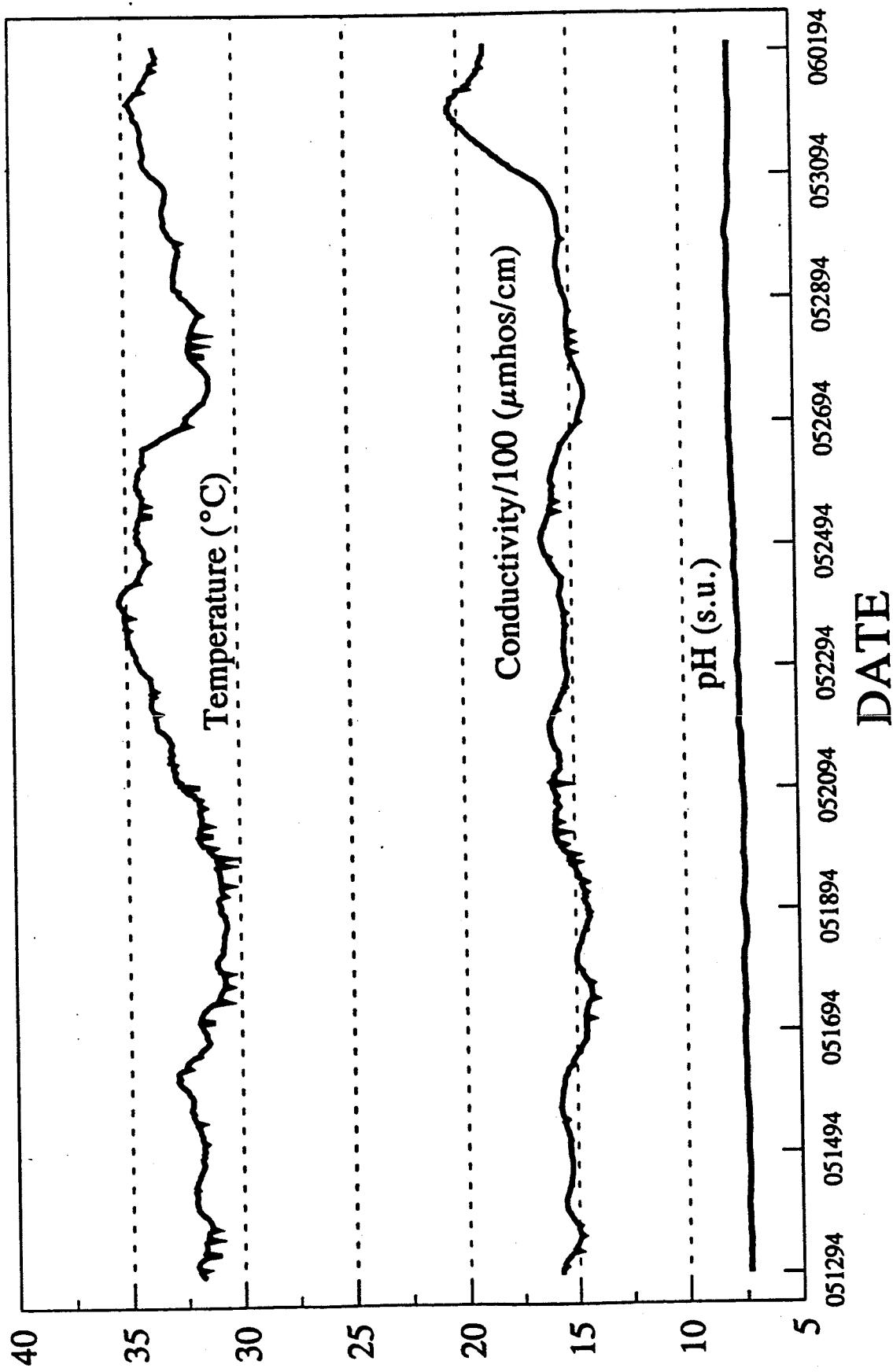
3.11 Substrate Analyses

Particle size distributions for all six sample sites are shown in Table 3-12. As expected from visual observations, the bottom substrate is primarily fine sand with some silt fractions. Current induced "dune" formations were visually observed in this dynamic setting using SCUBA.

TABLE 3-12 AMOCO BIOASSESSMENT - PARTICLE SIZE ANALYSES

DATE	SAMPLE	GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)
23-Apr-94	S120A	0	92	8	0
23-Apr-94	S120B	0	82	18	0
23-Apr-94	S340A	0	97	3	0
23-Apr-94	S340B	0	92	8	0
23-Apr-94	S650A	0	91	9	0
23-Apr-94	S650B	0	95	5	0
23-Apr-94	S1000A	0	89	11	0
23-Apr-94	S1000B	0	93	7	0
10-May-94	S2000A	0	94	4	2
10-May-94	S2000B	0	92	6	2
10-May-94	S3500A	0	82	14	4
10-May-94	S3500B	0	92	6	2

FIGURE 3-2
OUTFALL 001 MONITORING DATA



BENTHS2.XLS

Hill's N1		Density					
Mixzone	Lake	Mixzone	Lake				
2	2.1	88.8	1642.8				
1	1.62	88.8	710.4				
2	1.16	88.8	1243.2				
1	1.67	621.6	888				
1	1.45	88.8	710.4				
	1.53	0	1154.4				
	1.31	0	577.2				
	1.62	0	976.8				
	1.2		976.8				
	1.29		2486.4				
	1.38		3507.6				
	3.13		1198.8				
	1.64		222				
	1.56		266.4				
	3.78		227				
	2.67		532.8				
<i>Column 1</i>		Hill's	N1				
		Mixzone	Lake	Density			
Mean		1.4	1.819375			Mixzone	Lake
Standard Error	#N/A	0.186377	Mean			122.1	1082.563
Median		1	1.59	Standard Error		#N/A	216.4433
Mode		1	1.62	Median		88.8	932.4
Standard Deviation	0.547723	0.745506	Mode			88.8	710.4
Variance		0.3	0.55578	Standard Deviation		206.5572	865.7733
Kurtosis		-3.33333	2.358837	Variance		42665.86	749563.4
Skewness		0.608581	1.73201	Kurtosis		6.951005	3.436266
Range		1	2.62	Skewness		2.572337	1.76043
Minimum		1	1.16	Range		621.6	3285.6
Maximum		2	3.78	Minimum		0	222
Sum		7	29.11	Maximum		621.6	3507.6
Count		5	16	Sum		976.8	17321
				Count		8	16

PHYPLKTN.WKS

Amoco Cove Phytoplankton							
Richness		Simpson's D		Shannon-W		Evenness	
Mixzone	Lake	Mixzone	Lake	Mixzone	Lake	Mixzone	Lake
36	26	0.146	0.166	2.281	2.261	0.661	0.583
36	25	0.113	0.195	2.441	2.058	0.748	0.602
34	27	0.208	0.187	2.099	2.158	0.531	0.567
35	30	0.166	0.188	2.082	2.029	0.71	0.65
34	32	0.199	0.182	2.068	2.088	0.58	0.633
35	27	0.186	0.19	2.114	2.028	0.599	0.644
33	31	0.238	0.256	1.901	1.822	0.56	0.558
35	29	0.224	0.145	1.962	2.234	0.563	0.704
	31		0.169		2.162		0.635
	30		0.273		1.869		0.483
	26		0.187		2.026		0.657
	26		0.161		2.17		0.669
	26		0.161		2.245		0.615
	24		0.224		1.815		0.671
<i>RICHNESS</i>				<i>SIMPSON'S DIVERSITY</i>			
		<i>MIXZONE</i>	<i>LAKE</i>			<i>MIXZONE</i>	<i>LAKE</i>
Mean		34.75	27.85714	Mean		0.185	0.189231
Standard Error		#N/A	0.686264	Standard Error		#N/A	0.01015
Median		35	27	Median		0.1925	0.187
Mode		35	26	Mode		#N/A	0.187
Standard Deviation		1.035098	2.567763	Standard Deviation		0.041614	0.036597
Variance		1.071429	6.593407	Variance		0.001732	0.001339
Kurtosis		-0.448	-1.3912	Kurtosis		-0.34511	1.812484
Skewness		-0.38644	0.247946	Skewness		-0.57177	1.472629
Range		3	8	Range		0.125	0.128
Minimum		33	24	Minimum		0.113	0.145
Maximum		36	32	Maximum		0.238	0.273
Sum		278	390	Sum		1.48	2.46
Count		8	14	Count		8	.13
<i>SHANNON'S DIVERSITY</i>				<i>EVENNESS</i>			
		<i>MIXZONE</i>	<i>LAKE</i>			<i>MIXZONE</i>	<i>LAKE</i>
Mean		2.1185	2.068929	Mean		0.619	0.619357
Standard Error		#N/A	0.040122	Standard Error		#N/A	0.015269
Median		2.0905	2.073	Median		0.5895	0.634
Mode		#N/A	#N/A	Mode		#N/A	#N/A
Standard Deviation		0.171753	0.150121	Standard Deviation		0.078347	0.057131
Variance		0.029499	0.022536	Variance		0.006138	0.003264
Kurtosis		0.758118	-0.75937	Kurtosis		-0.95986	1.180227
Skewness		0.884452	-0.53156	Skewness		0.730572	-0.95931
Range		0.54	0.446	Range		0.217	0.221
Minimum		1.901	1.815	Minimum		0.531	0.483
Maximum		2.441	2.261	Maximum		0.748	0.704
Sum		16.948	28.965	Sum		4.952	8.671
Count		8	14	Count		8	14

PHYPLKTN.WKS

Hill's N1		% of Richness		Density	
Mixzone	Lake	Mixzone	Lake	Mixzone	Lake
9.79	9.59	54.39	47.95	3.11	3.53
11.48	7.83	63.78	48.94	2.66	2.16
8.16	8.65	48	45.53	1.76	3.96
8.02	7.6	53.47	54.29	3.62	2.04
7.9	8.07	46.47	53.8	2.2	2.94
8.28	7.6	43.58	44.71	2.43	3.97
6.698	6.18	44.65	36.35	2.11	2.61
7.11	9.34	44.44	46.7	2.8	2.77
	8.69		45.74		1.69
	6.48		40.5		2.05
	7.58		54.14		2.97
	8.76		54.75		2.32
	9.44		47.2		2.44
	6.14		47.23		6.44
HILL'S N1				% N1 OF RICHNESS	
		MIXZONE		LAKE	
Mean	8.42975	7.996429	Mean	49.8475	47.70214
Standard Error	#N/A	0.309962	Standard Error	#N/A	1.431664
Median	8.09	7.95	Median	47.235	47.215
Mode	#N/A	7.6	Mode	#N/A	#N/A
Standard Deviation	1.532445	1.159772	Standard Deviation	6.951143	5.356795
Variance	2.348389	1.345071	Variance	48.31839	28.69525
Kurtosis	1.44922	-0.93669	Kurtosis	1.201532	0.152609
Skewness	1.226019	-0.31875	Skewness	1.279533	-0.4384
Range	4.782	3.45	Range	20.2	18.4
Minimum	6.698	6.14	Minimum	43.58	36.35
Maximum	11.48	9.59	Maximum	63.78	54.75
Sum	67.438	111.95	Sum	398.78	667.83
Count	8	14	Count	8	14
		DENSITY			
		MIXZONE		LAKE	
Mean		2.58625	2.992143		
Standard Error		#N/A	0.324862		
Median		2.545	2.69		
Mode		#N/A	#N/A		
Standard Deviation		0.594881	1.215523		
Variance		0.353884	1.477495		
Kurtosis		-0.08236	4.482732		
Skewness		0.475029	1.89698		
Range		1.86	4.75		
Minimum		1.76	1.69		
Maximum		3.62	6.44		
Sum		20.69	41.89		
Count		8	14		

ZOOPLKTN.WKS

Amoco Cove Zooplankton							
Richness		Simpson's D		Shannon-W		Evenness	
Mixzone	Lake	Mixzone	Lake	Mixzone	Lake	Mixzone	Lake
12	11	0.699	0.777	0.762	0.572	0.376	0.369
13	12	0.746	0.821	0.588	0.479	0.423	0.353
11	11	0.64	0.797	0.82	0.527	0.417	0.365
11	13	0.81	0.462	0.497	0.878	0.361	0.826
10	13	0.9	0.459	0.261	0.915	0.353	0.785
10	15	0.955	0.426	0.146	1.06	0.296	0.71
	RICHNESS				SIMPSON'S	DIVERSITY	
		Mixzone	Lake			Mixzone	Lake
Mean		11.16667	12.5	Mean		0.791667	0.623667
Standard Error		0.477261	0.619139	Standard Error		0.049134	0.07849
Median		11	12.5	Median		0.778	0.6195
Mode		11	11	Mode		#N/A	#N/A
Standard Deviation		1.169045	1.516575	Standard Deviation		0.120354	0.19226
Variance		1.366667	2.3	Variance		0.014485	0.036964
Kurtosis		-0.44616	0.283554	Kurtosis		-1.38987	-3.21871
Skewness		0.667628	0.774055	Skewness		0.216003	0.003522
Range		3	4	Range		0.315	0.395
Minimum		10	11	Minimum		0.64	0.426
Maximum		13	15	Maximum		0.955	0.821
Sum		67	75	Sum		4.75	3.742
Count		6	6	Count		6	6
	SHANNON	DIVERSITY				EVENNESS	
		Mixzone	Lake			Mixzone	Lake
				Mean		0.371	0.568
Mean		0.512333	0.7385	Standard Error		0.019056	0.093247
Standard Error		0.109593	0.098956	Median		0.3685	0.5395
Median		0.5425	0.725	Mode		#N/A	#N/A
Mode		#N/A	#N/A	Standard Deviation		0.046678	0.228408
Standard Deviation		0.268448	0.242392	Variance		0.002179	0.05217
Variance		0.072064	0.058754	Kurtosis		0.171028	-3.04599
Kurtosis		-1.54872	-2.32882	Skewness		-0.56235	0.102484
Skewness		-0.30895	0.20839	Range		0.127	0.473
Range		0.674	0.581	Minimum		0.296	0.353
Minimum		0.146	0.479	Maximum		0.423	0.826
Maximum		0.82	1.06	Sum		2.226	3.408
Sum		3.074	4.431	Count		6	6
Count		6	6				

ZOOPLKTN.WKS

FLOATP.WKS

Amoco Cove Float Periphyton							
Richness	Simpson's D		Shannon-W		Evenness		
Mixzone	Lake	Mixzone	Lake	Mixzone	Lake	Mixzone	Lake
21	22	0.22	0.17	1.49	1.69	1.03	1.11
22	22	0.15	0.19	1.75	1.51	1.17	1.22
23	22	0.15	0.17	1.7	1.64	1.24	1.19
24	27	0.11	0.17	2	1.63	1.2	1.19
17	26	0.22	0.19	1.48	1.49	1.03	1.21
18	27	0.2	0.15	1.47	1.69	1.18	1.24
	26		0.15		1.68		1.22
	RICHNESS					SIMPSON'S	DIVERSITY
		mixzone	lake			mixzone	lake
Mean		20.83333	24.57143	Mean		0.175	0.17
Standard Error		#N/A	0.922139	Standard Error		#N/A	0.006172
Median		21.5	26	Median		0.175	0.17
Mode		#N/A	22	Mode		0.22	0.17
Standard Deviation		2.786874	2.43975	Standard Deviation		0.045056	0.01633
Variance		7.766667	5.952381	Variance		0.00203	0.000267
Kurtosis		-1.55225	-2.64634	Kurtosis		-1.62562	-1.2
Skewness		-0.49281	-0.2656	Skewness		-0.35424	3.83E-15
Range		7	5	Range		0.11	0.04
Minimum		17	22	Minimum		0.11	0.15
Maximum		24	27	Maximum		0.22	0.19
Sum		125	172	Sum		1.05	1.19
Count		6	7	Count		6	7
	SHANNON - W		DIVERSITY			EVENNESS	
		Mixzone	Lake			Mixzone	Lake
Mean		1.648333	1.618571	Mean		1.141667	1.197143
Standard Error		#N/A	0.031954	Standard Error		#N/A	0.015993
Median		1.595	1.64	Median		1.175	1.21
Mode		#N/A	1.69	Mode		1.03	1.22
Standard Deviation		0.210658	0.084544	Standard Deviation		0.089759	0.042314
Variance		0.044377	0.007148	Variance		0.008057	0.00179
Kurtosis		0.095259	-1.02695	Kurtosis		-1.73299	3.569834
Skewness		0.971358	-0.93953	Skewness		-0.64569	-1.71778
Range		0.53	0.2	Range		0.21	0.13
Minimum		1.47	1.49	Minimum		1.03	1.11
Maximum		2	1.69	Maximum		1.24	1.24
Sum		9.89	11.33	Sum		6.85	8.38
Count		6	7	Count		6	7

FLOATP.WKS

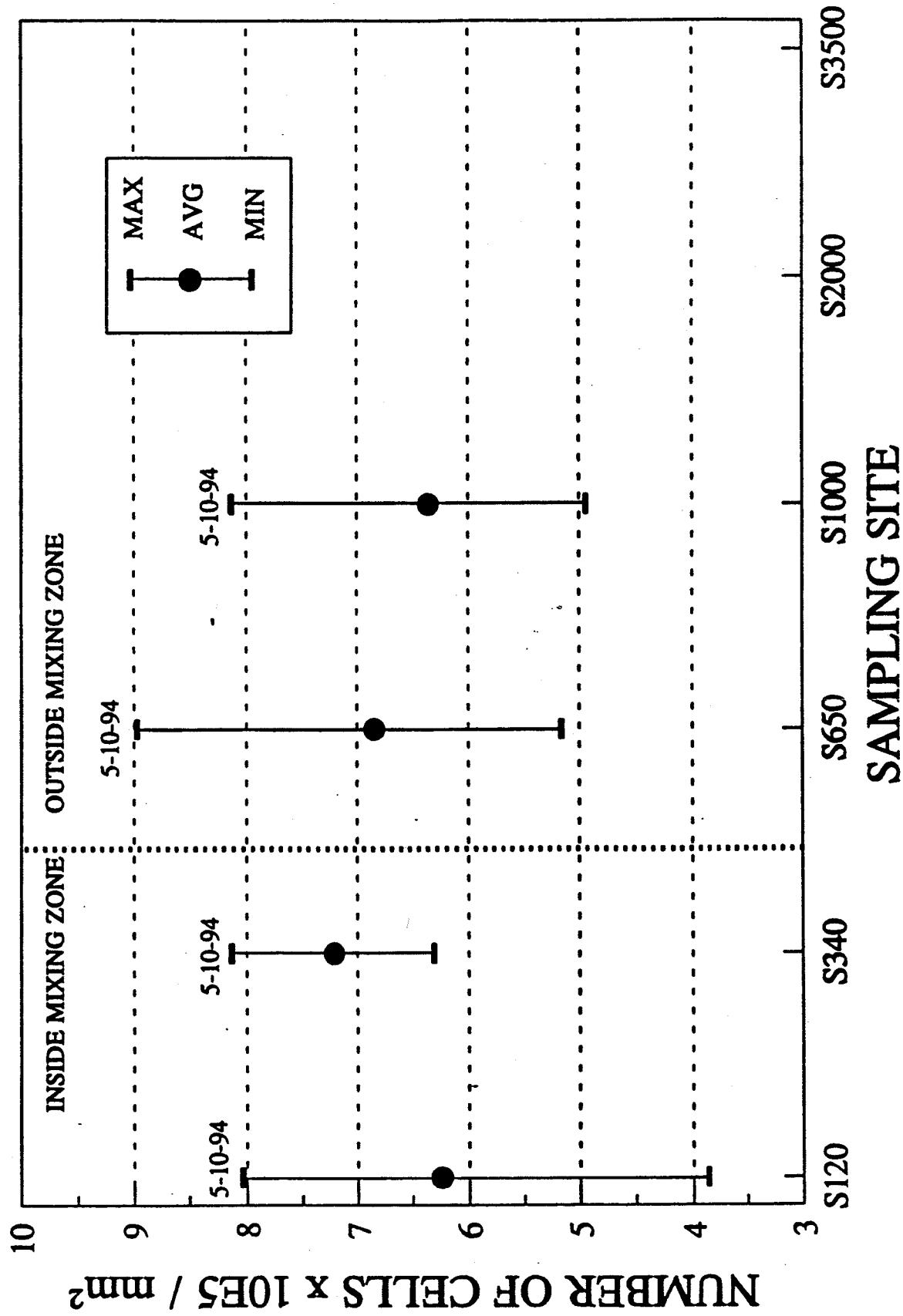
SHOREP.WKS

Amoco Cove Shore Periphyton							
Richness		Simpson's D		Shannon-W		Evenness	
Mixzone	Lake	Mixzone	Lake	Mixzone	Lake	Mixzone	Lake
6	5	0.16	0.18	1.69	1.43	1.21	1.2
8	6	0.09	0.21	1.97	1.65	1.48	1.26
6	6	0.14	0.16	1.71	1.56	1.31	1.12
10	5	0.11	0.19	2.19	1.52	1.19	1.27
<i>RICHNESS</i>							
		Mixzone	Lake			Mixzone	Lake
Mean		7.5	5.5	Mean		0.125	0.185
Standard Error		0.957427	0.288675	Standard Error		0.015546	0.010408
Median		7	5.5	Median		0.125	0.185
Mode		6	5	Mode		#N/A	#N/A
Standard Deviation		1.914854	0.57735	Standard Deviation		0.031091	0.020817
Variance		3.666667	0.333333	Variance		0.000967	0.000433
Kurtosis		-1.28926	-6	Kurtosis		-2.43282	0.390533
Skewness		0.854563	0	Skewness		2.04E-16	5.78E-17
Range		4	1	Range		0.07	0.05
Minimum		6	5	Minimum		0.09	0.16
Maximum		10	6	Maximum		0.16	0.21
Sum		30	22	Sum		0.5	0.74
Count		4	4	Count		4	4
<i>SIMPSON'S DIVERSITY</i>							
		Mixzone	Lake			Mixzone	Lake
Mean		1.89	1.54	Mean		1.2975	1.2125
Standard Error		0.118603	0.045644	Standard Error		0.066254	0.03449
Median		1.84	1.54	Median		1.26	1.23
Mode		#N/A	#N/A	Mode		#N/A	#N/A
Standard Deviation		0.237206	0.091287	Standard Deviation		0.132508	0.068981
Variance		0.056267	0.008333	Variance		0.017558	0.004758
Kurtosis		-2.13873	0.57072	Kurtosis		0.571971	-0.3597
Skewness		0.68331	-7E-15	Skewness		1.194331	-1.00767
Range		0.5	0.22	Range		0.29	0.15
Minimum		1.69	1.43	Minimum		1.19	1.12
Maximum		2.19	1.65	Maximum		1.48	1.27
Sum		7.56	6.16	Sum		5.19	4.85
Count		4	4	Count		4	4
<i>SHANNON-W EVENNESS</i>							
		Mixzone	Lake			Mixzone	Lake
Mean		1.89	1.54	Mean		1.2975	1.2125
Standard Error		0.118603	0.045644	Standard Error		0.066254	0.03449
Median		1.84	1.54	Median		1.26	1.23
Mode		#N/A	#N/A	Mode		#N/A	#N/A
Standard Deviation		0.237206	0.091287	Standard Deviation		0.132508	0.068981
Variance		0.056267	0.008333	Variance		0.017558	0.004758
Kurtosis		-2.13873	0.57072	Kurtosis		0.571971	-0.3597
Skewness		0.68331	-7E-15	Skewness		1.194331	-1.00767
Range		0.5	0.22	Range		0.29	0.15
Minimum		1.69	1.43	Minimum		1.19	1.12
Maximum		2.19	1.65	Maximum		1.48	1.27
Sum		7.56	6.16	Sum		5.19	4.85
Count		4	4	Count		4	4

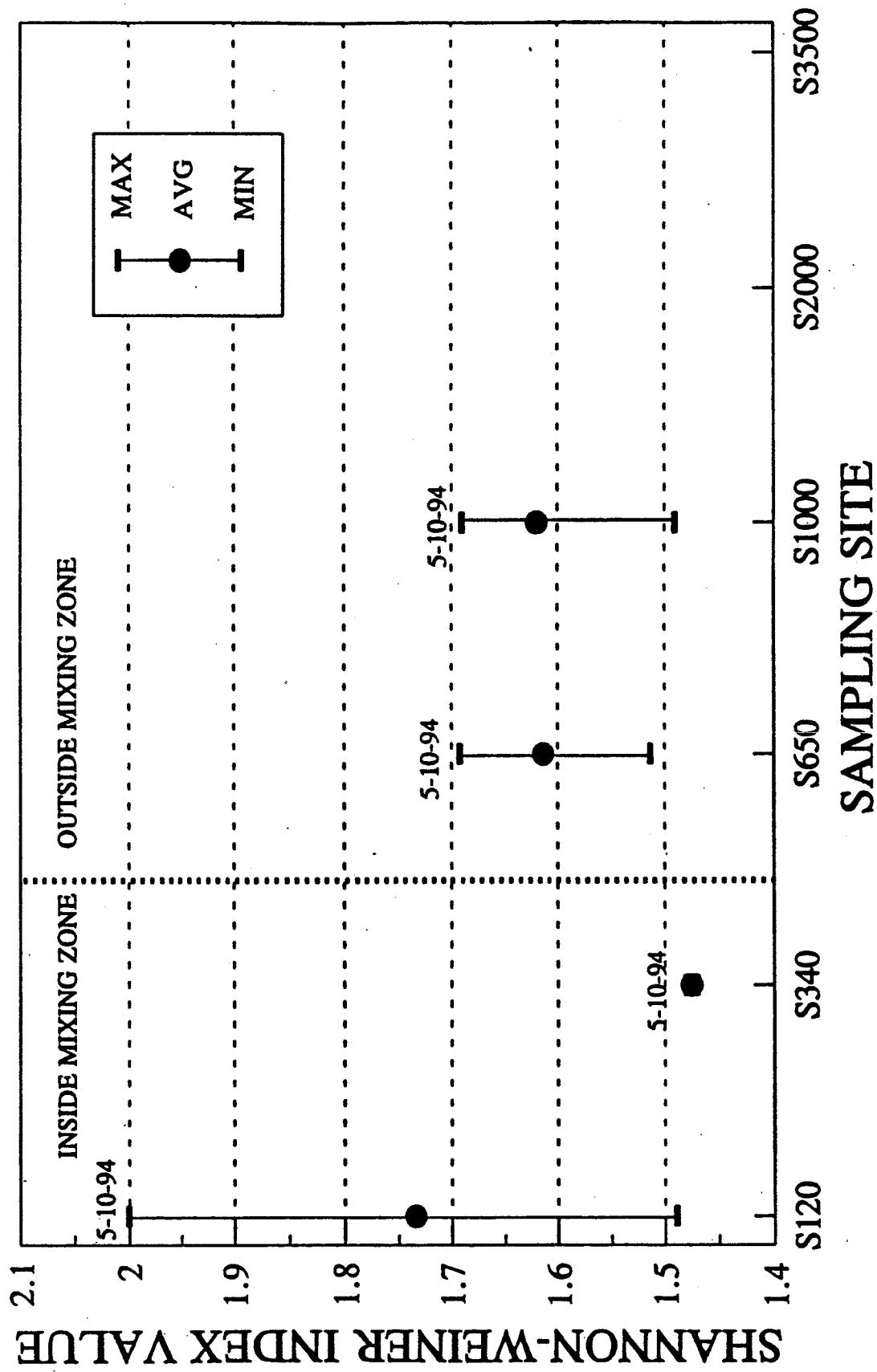


DESCRIPTIVE STATISTICS

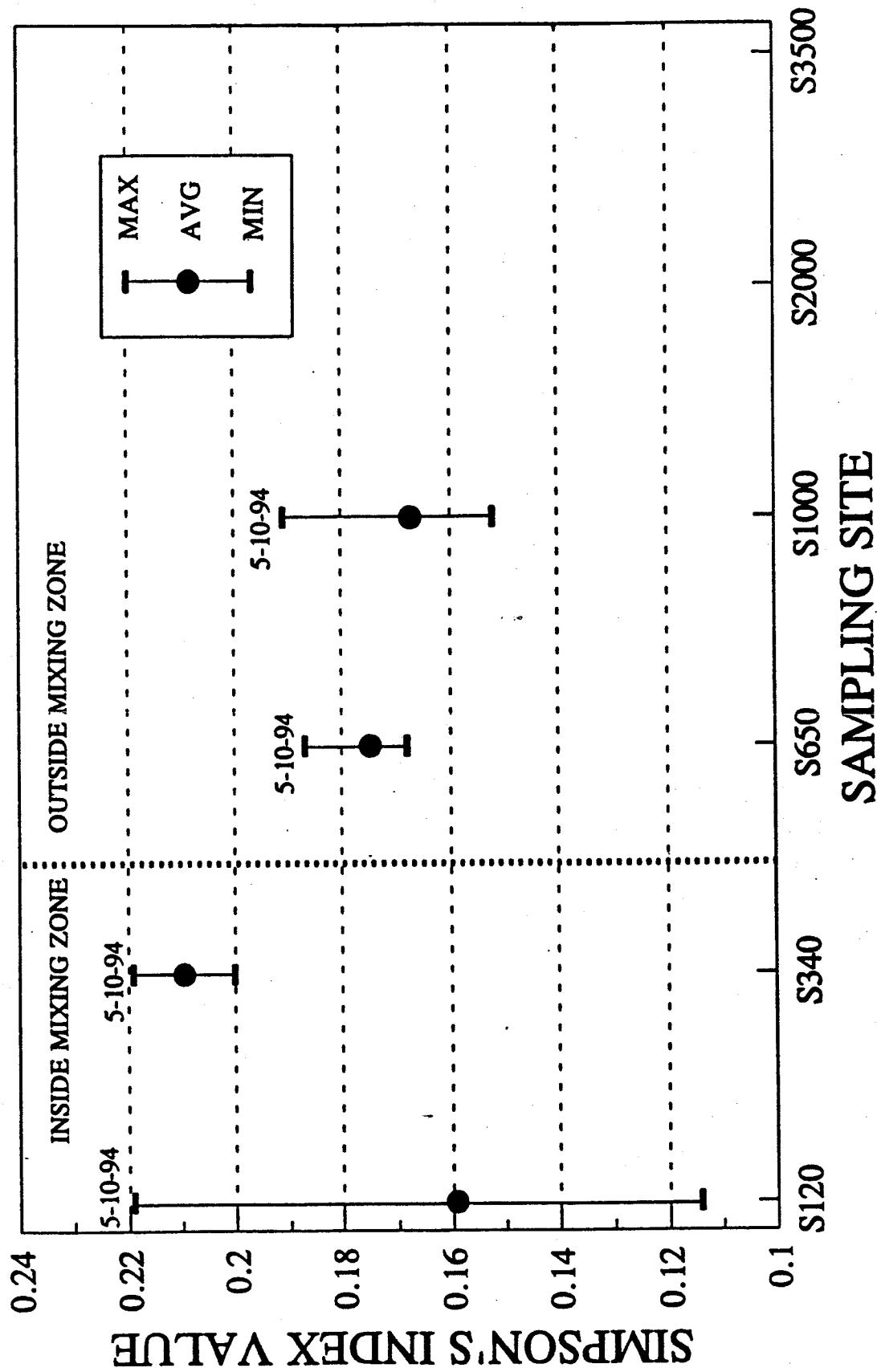
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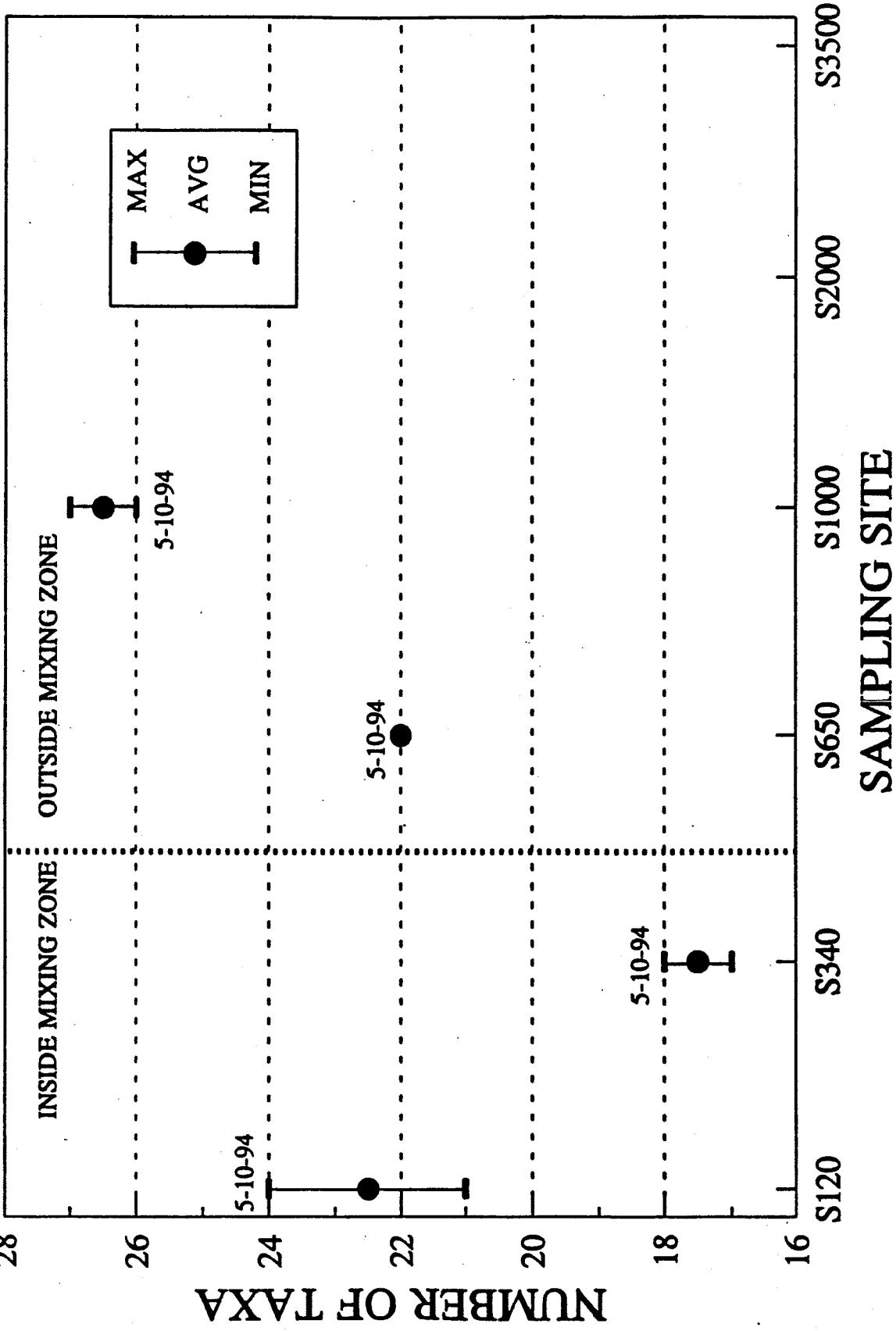
FLOAT PERIPHYTON DIVERSITY SHANNON-WEINER DIVERSITY INDEX



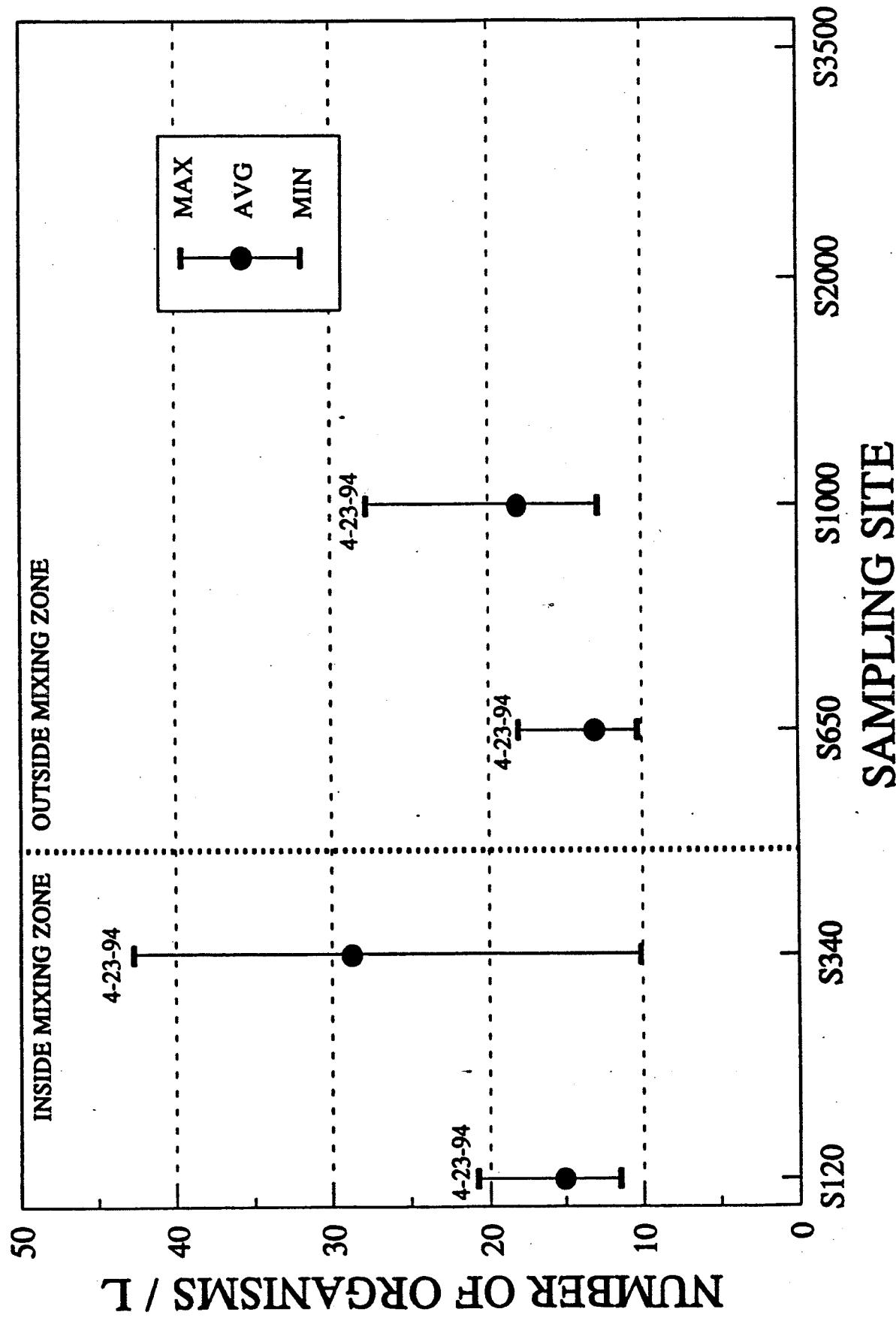
FLOAT PERIPHERYTON DIVERSITY SIMPSON'S DIVERSITY INDEX



FLOAT PERIPHERY RICHNESS

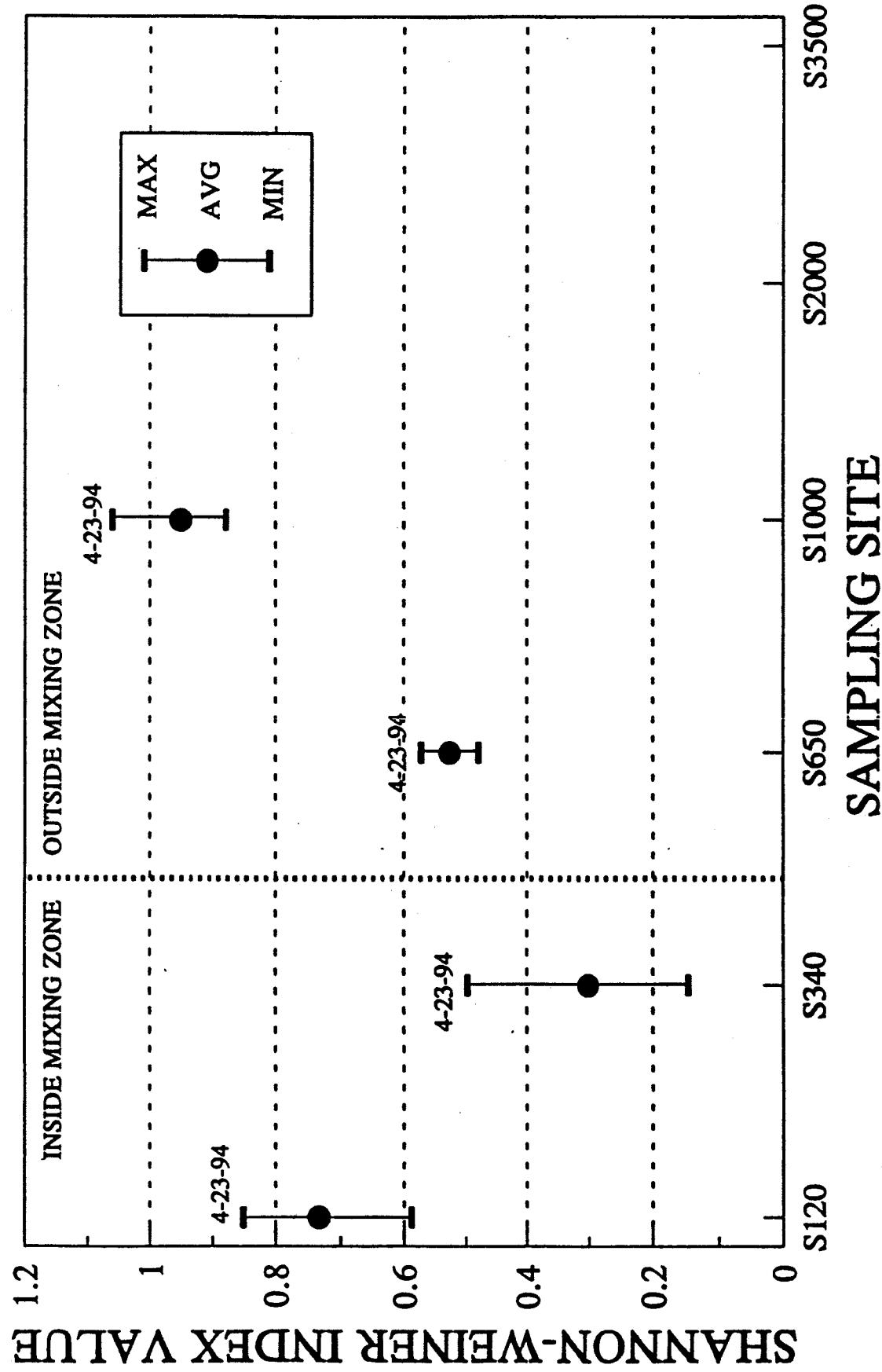


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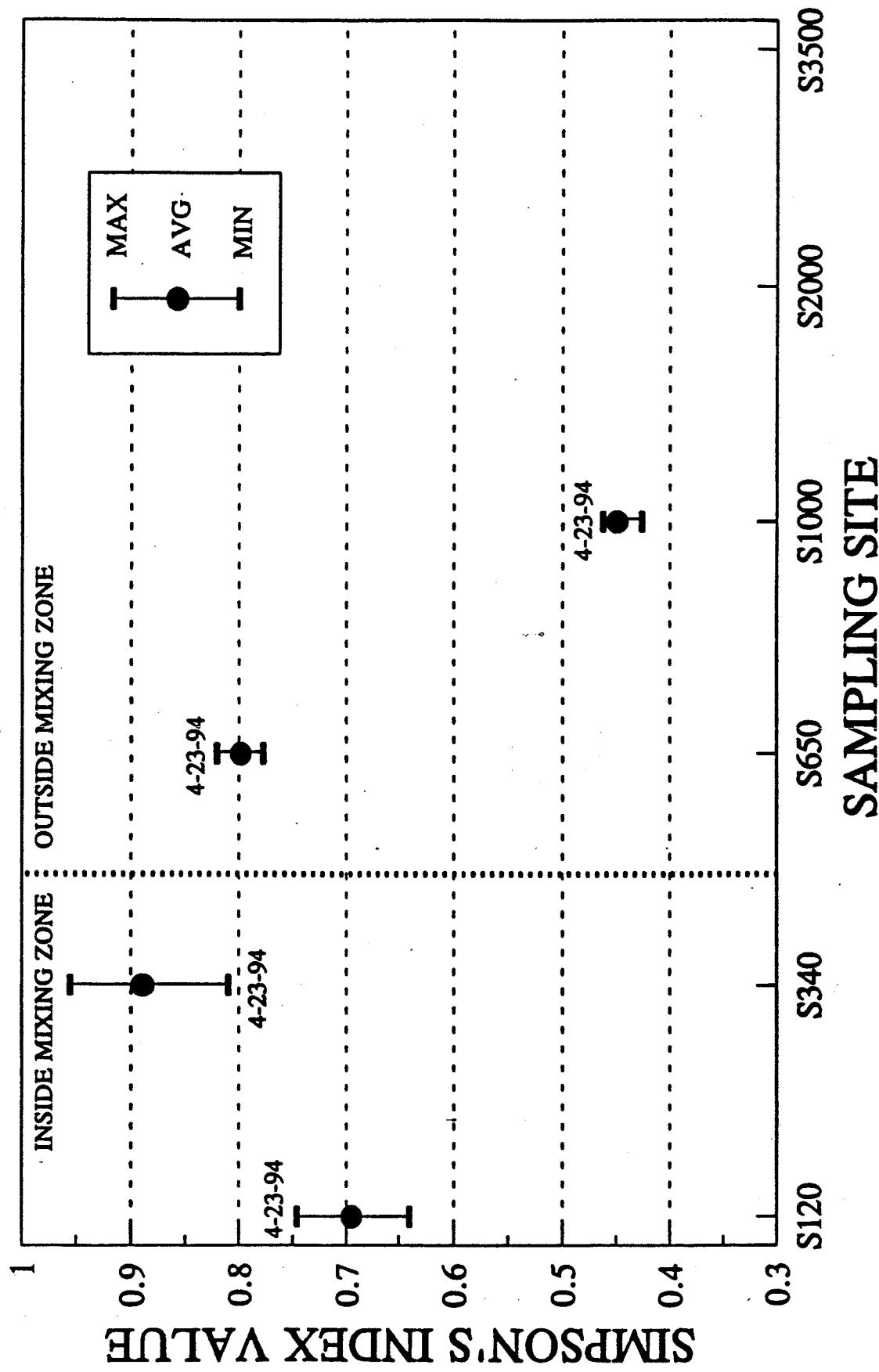


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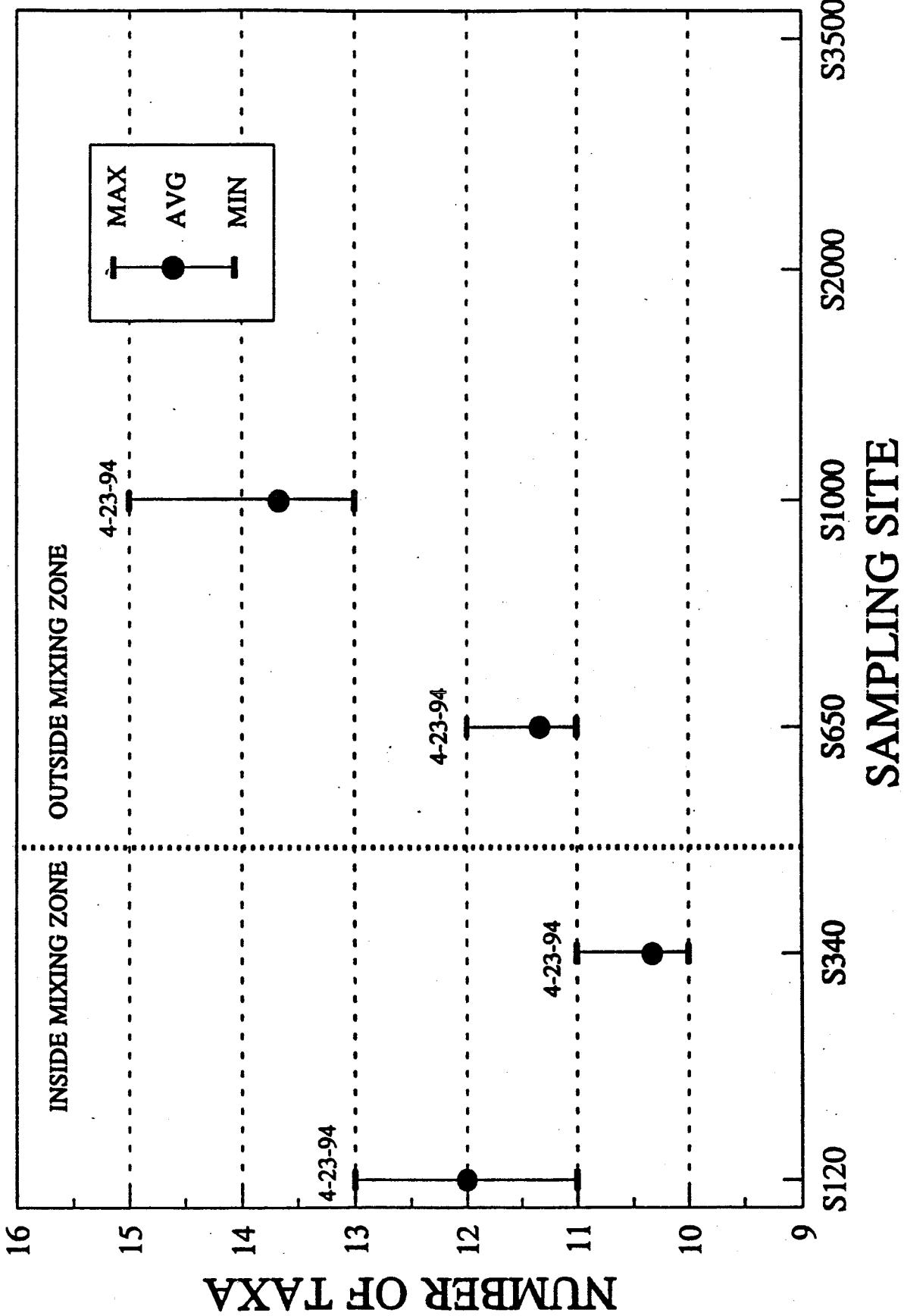
SHANNON-WEINER DIVERSITY INDEX



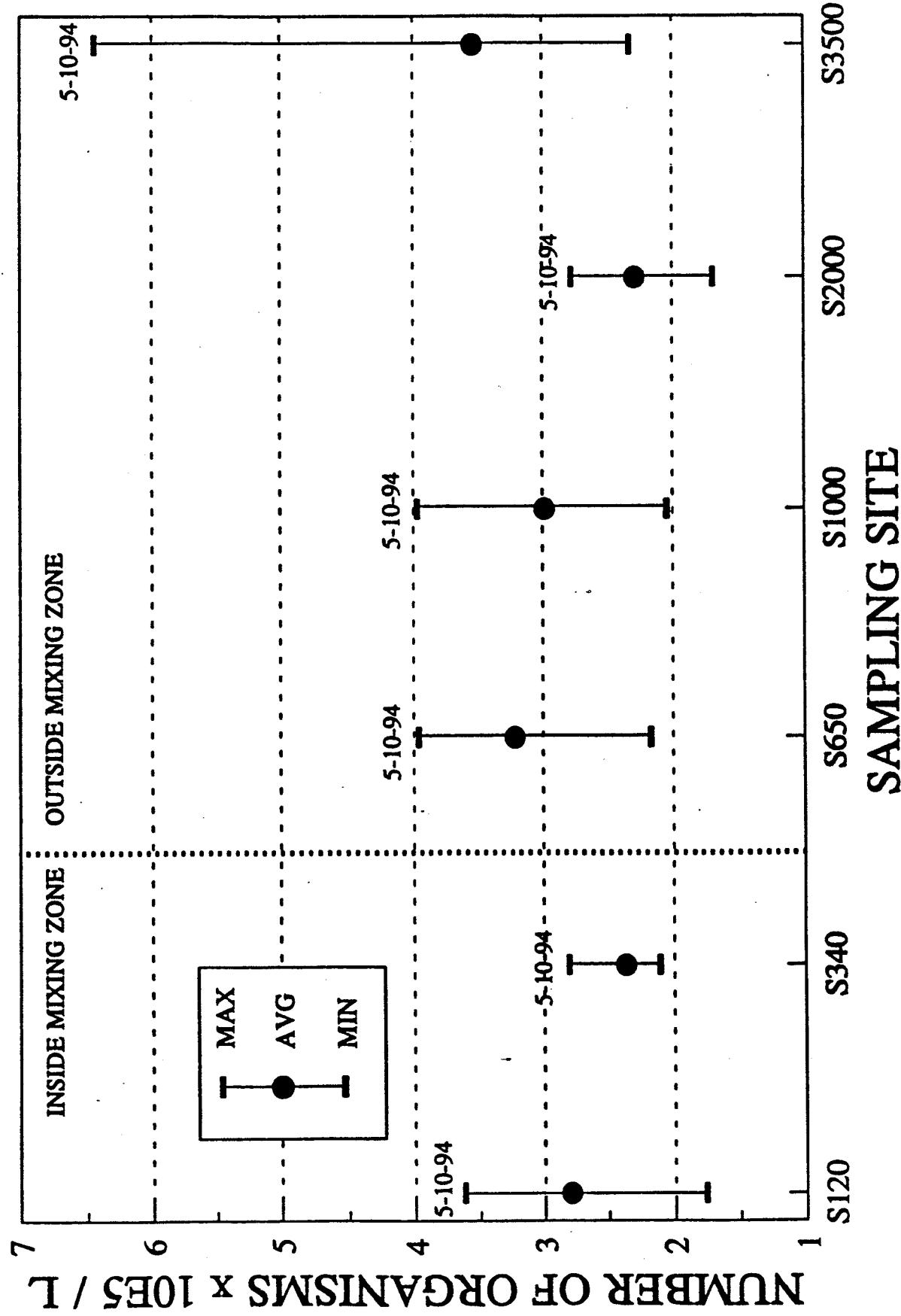
ZOOPLANKTON DIVERSITY SIMPSON'S DIVERSITY INDEX



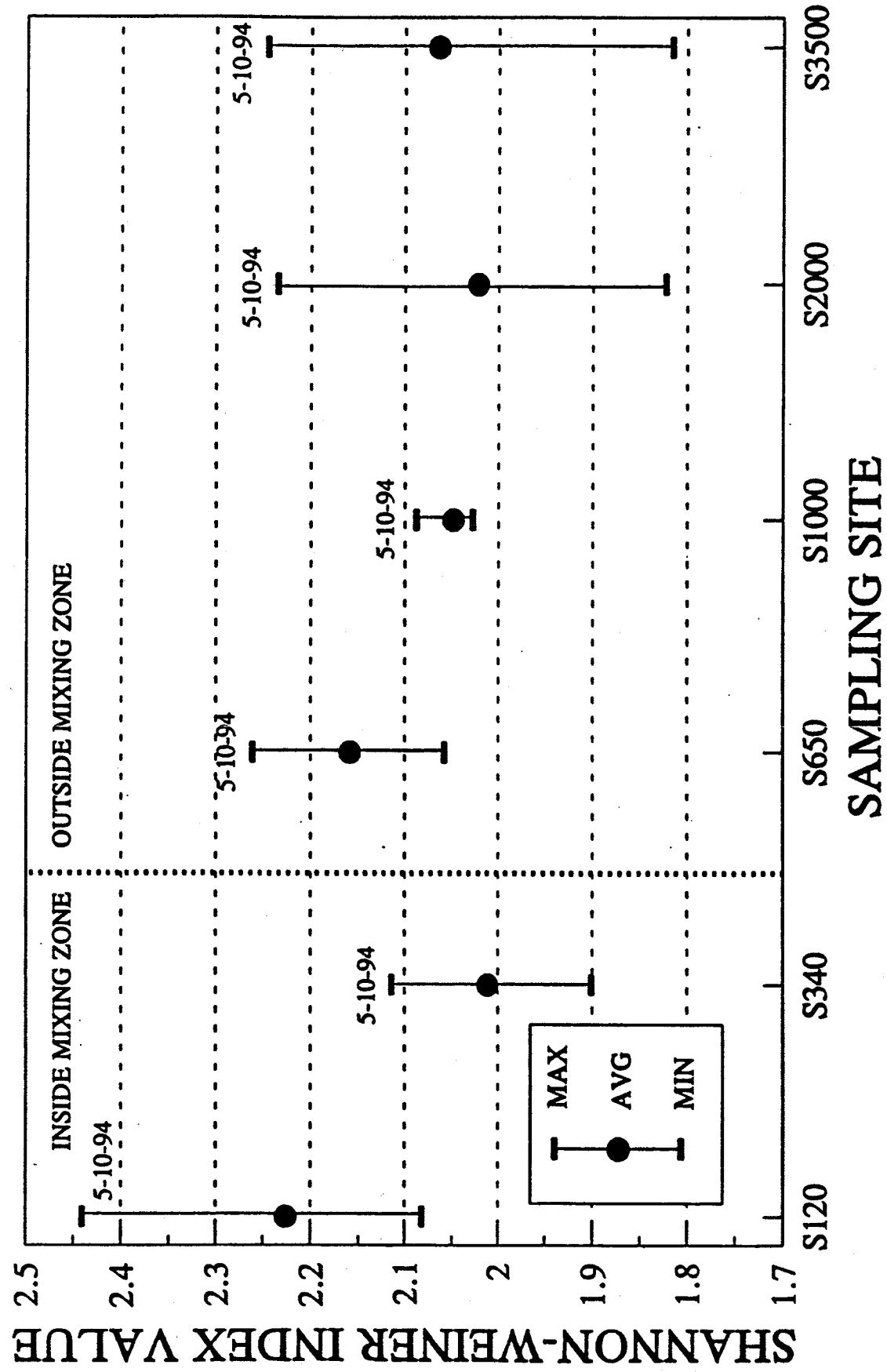
ZOOPLANKTON RICHNESS



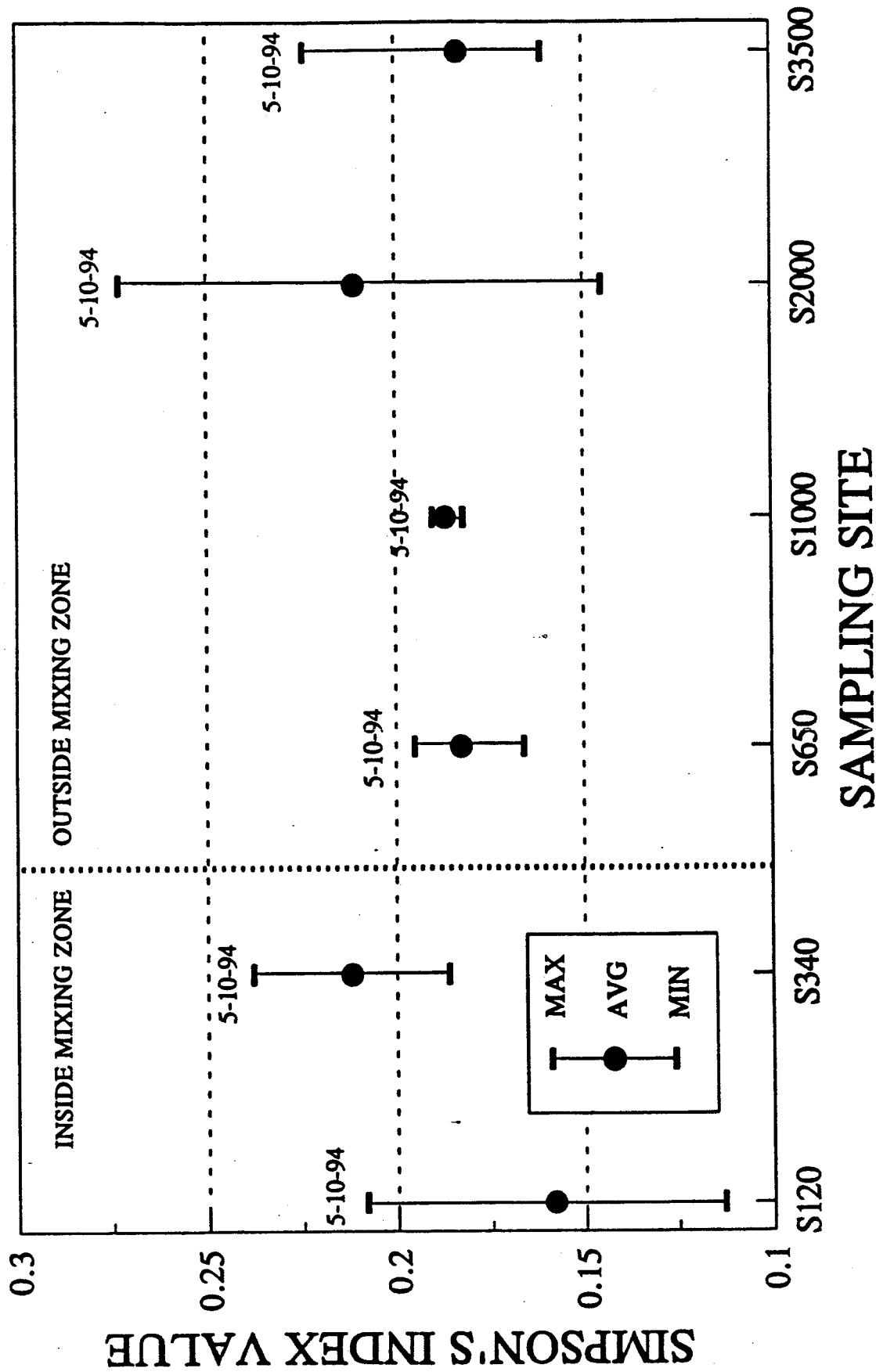
PHYTOPLANKTON DENSITY



PHYTOPLANKTON DIVERSITY SHANNON-WEINER DIVERSITY INDEX

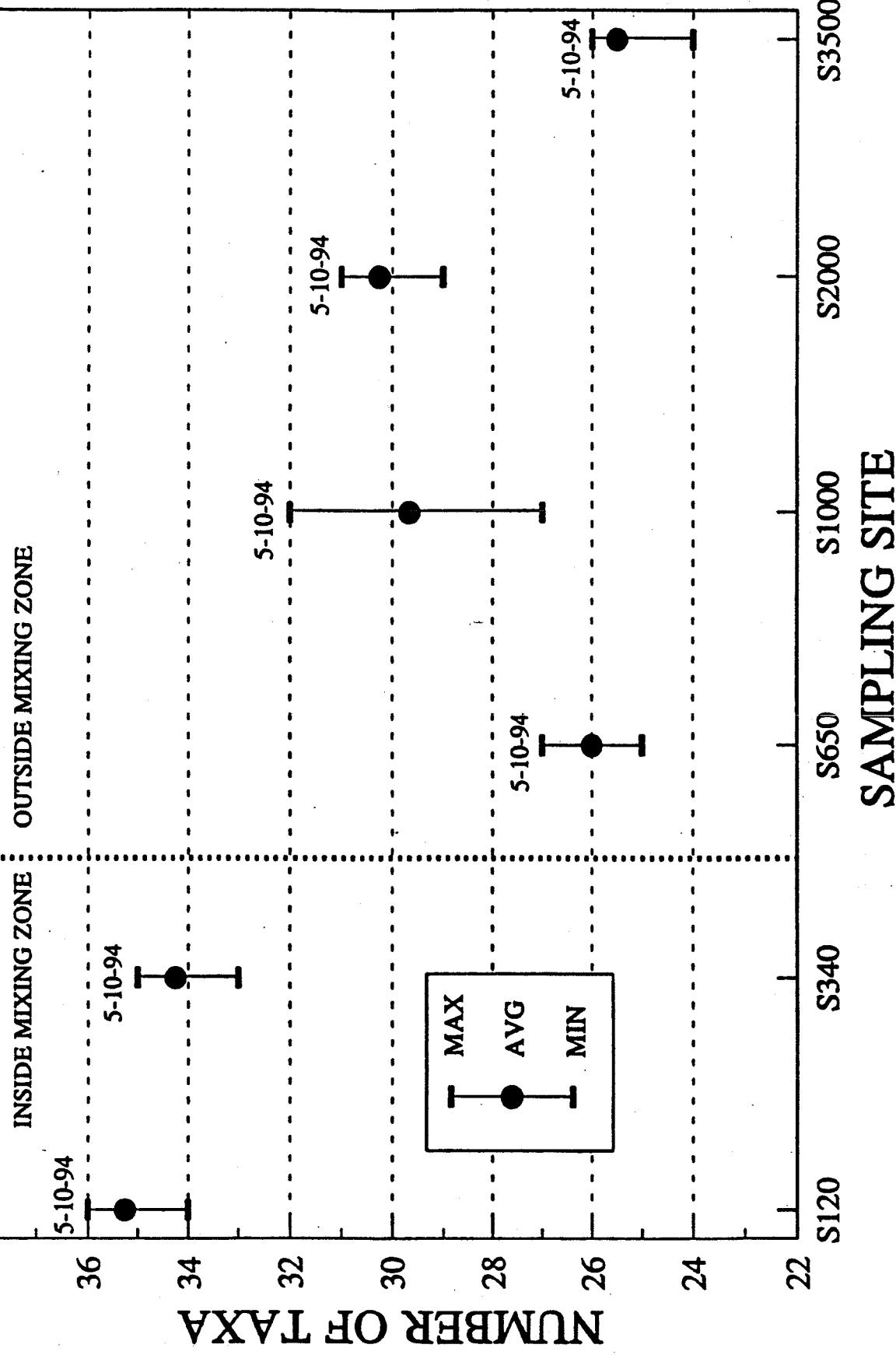


PHYTOPLANKTON DIVERSITY SIMPSON'S DIVERSITY INDEX

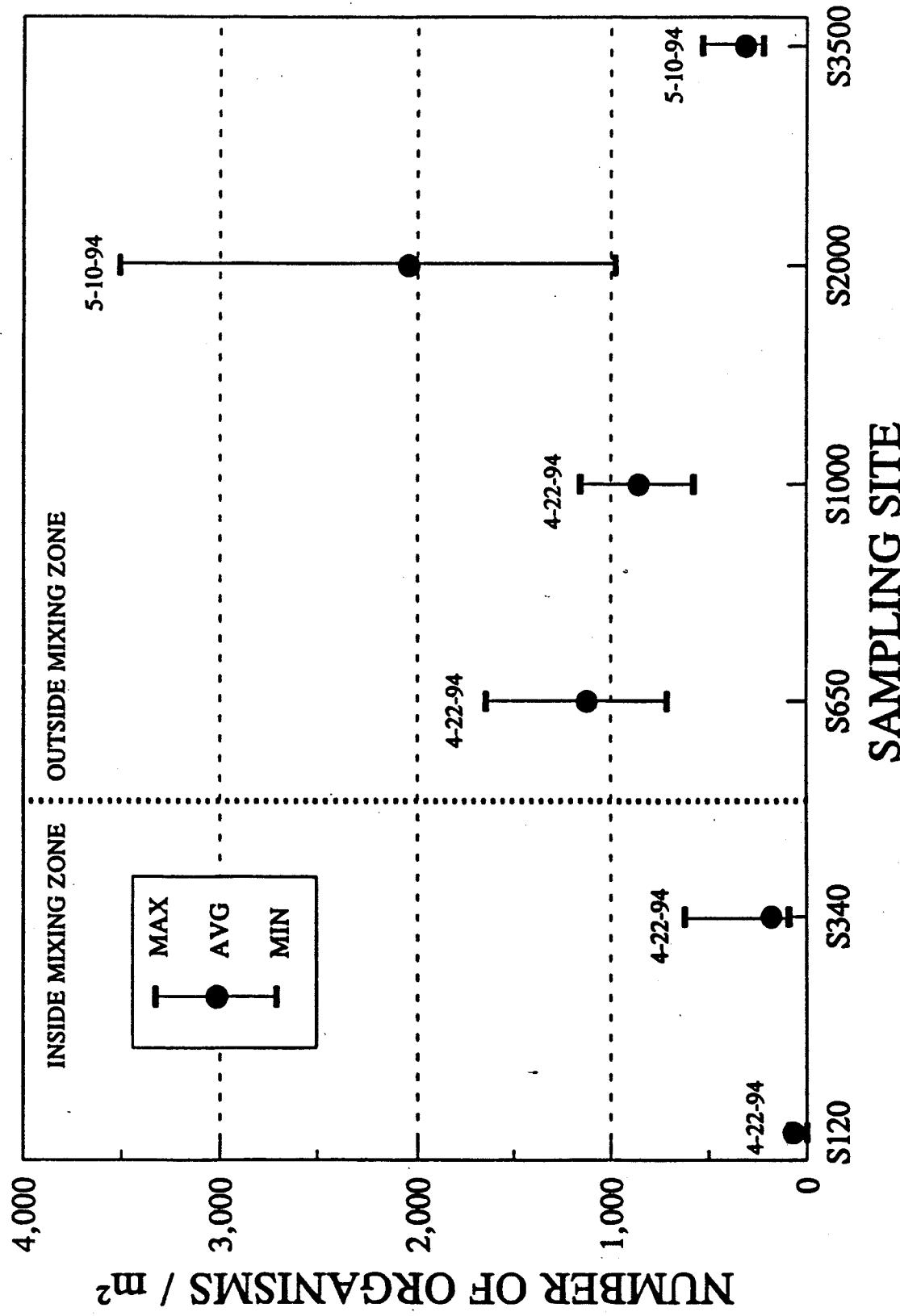


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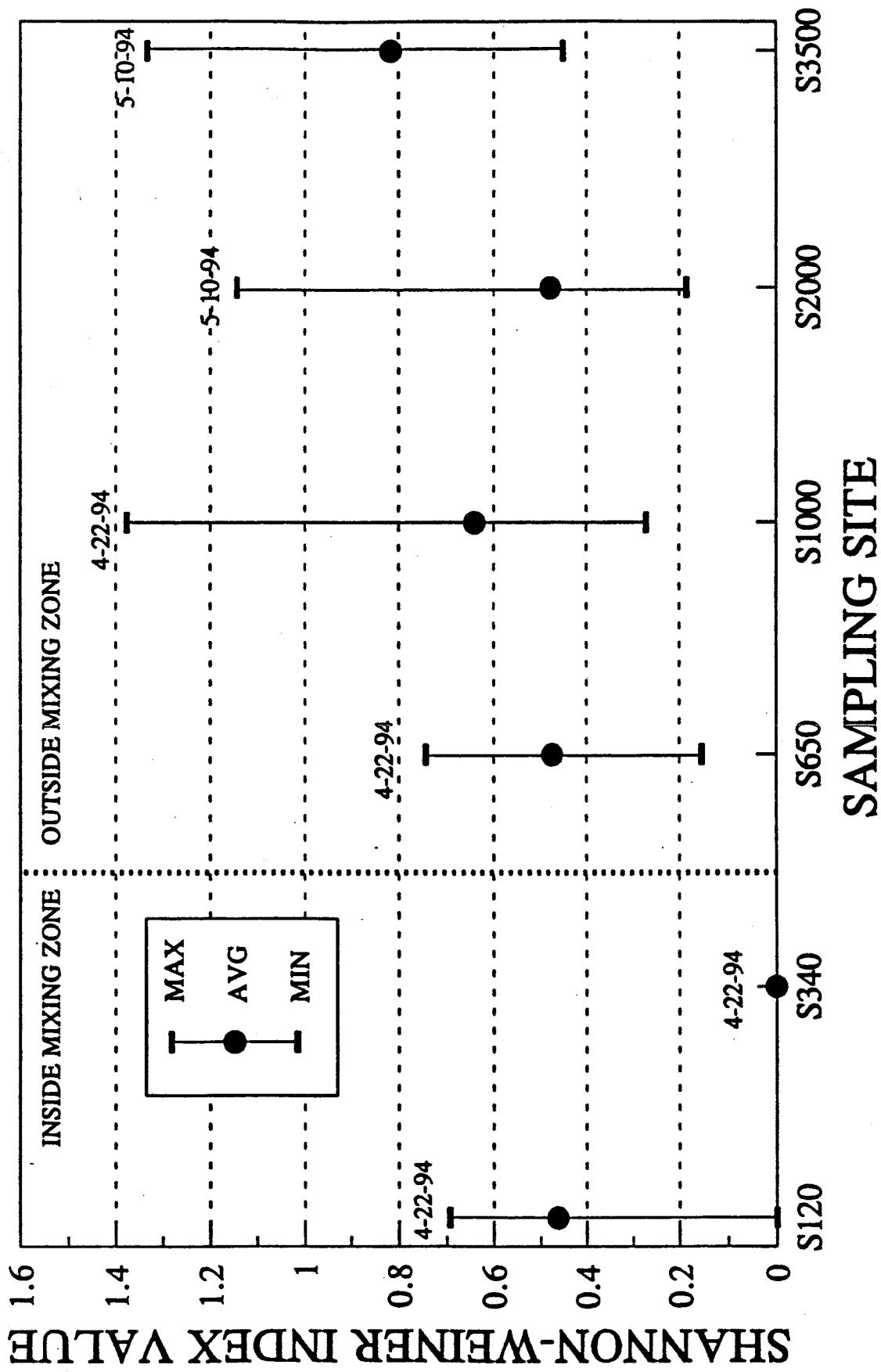
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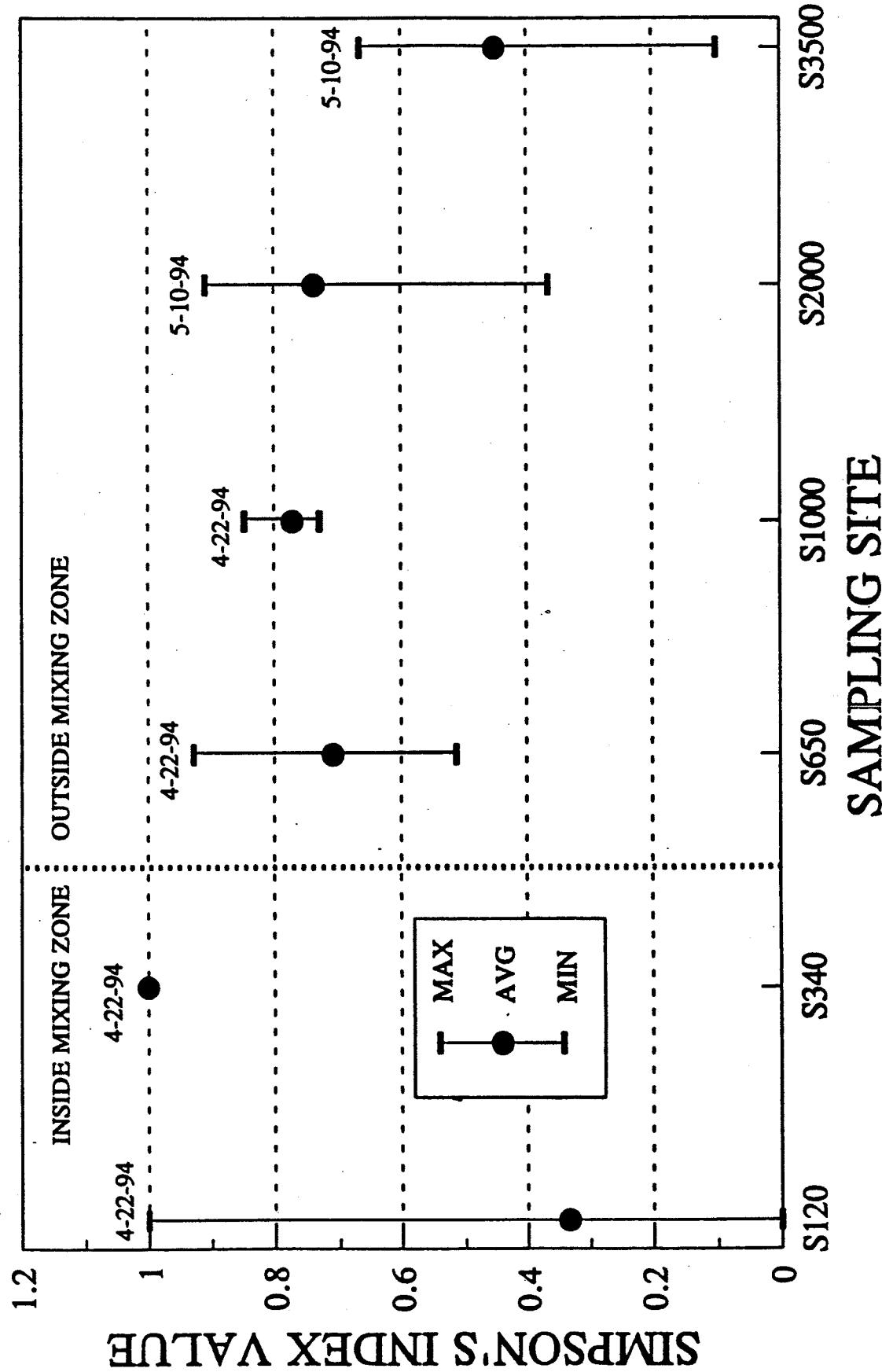
BENTHOS DENSITY



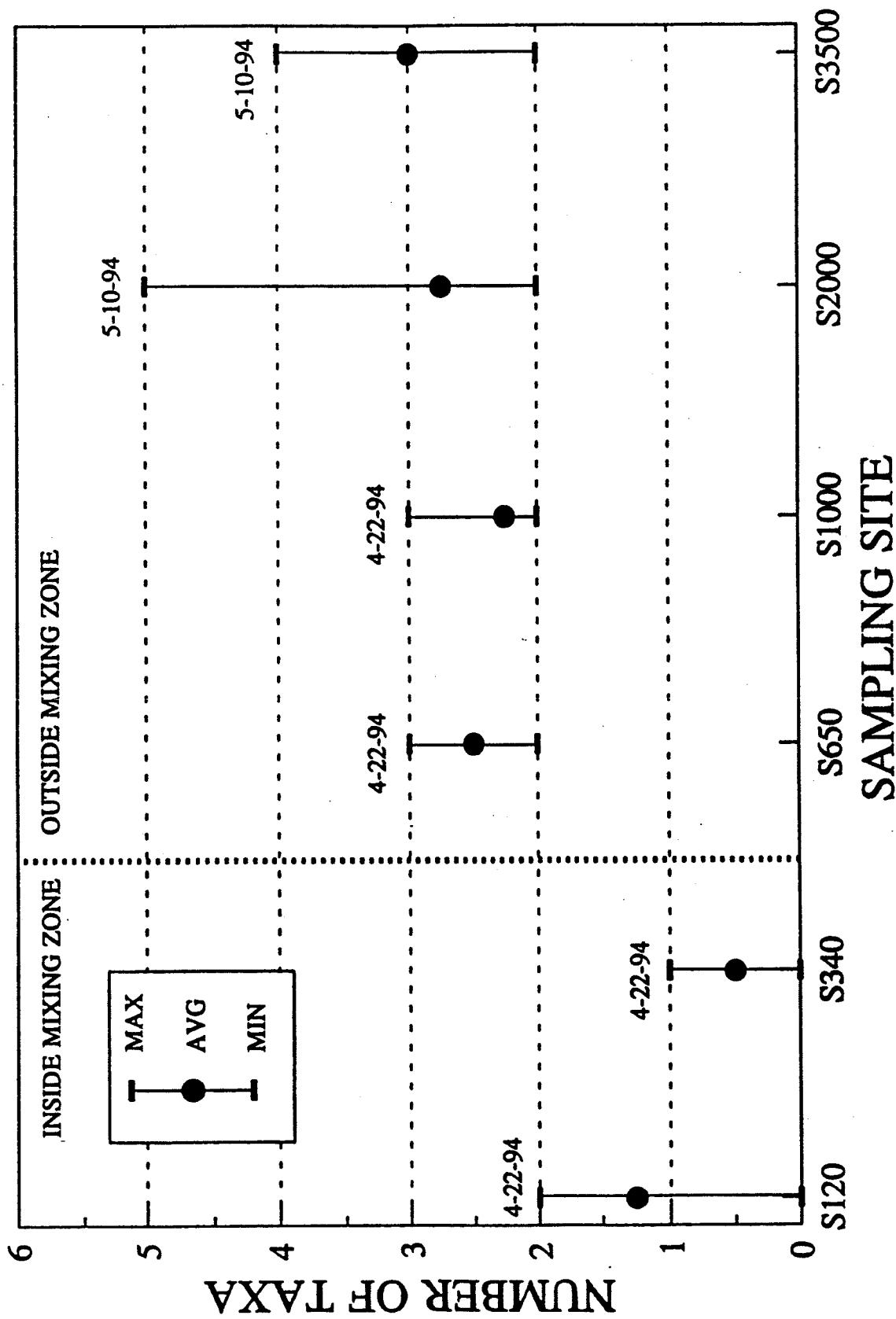
BENTHOS DIVERSITY SHANNON-WEINER DIVERSITY INDEX



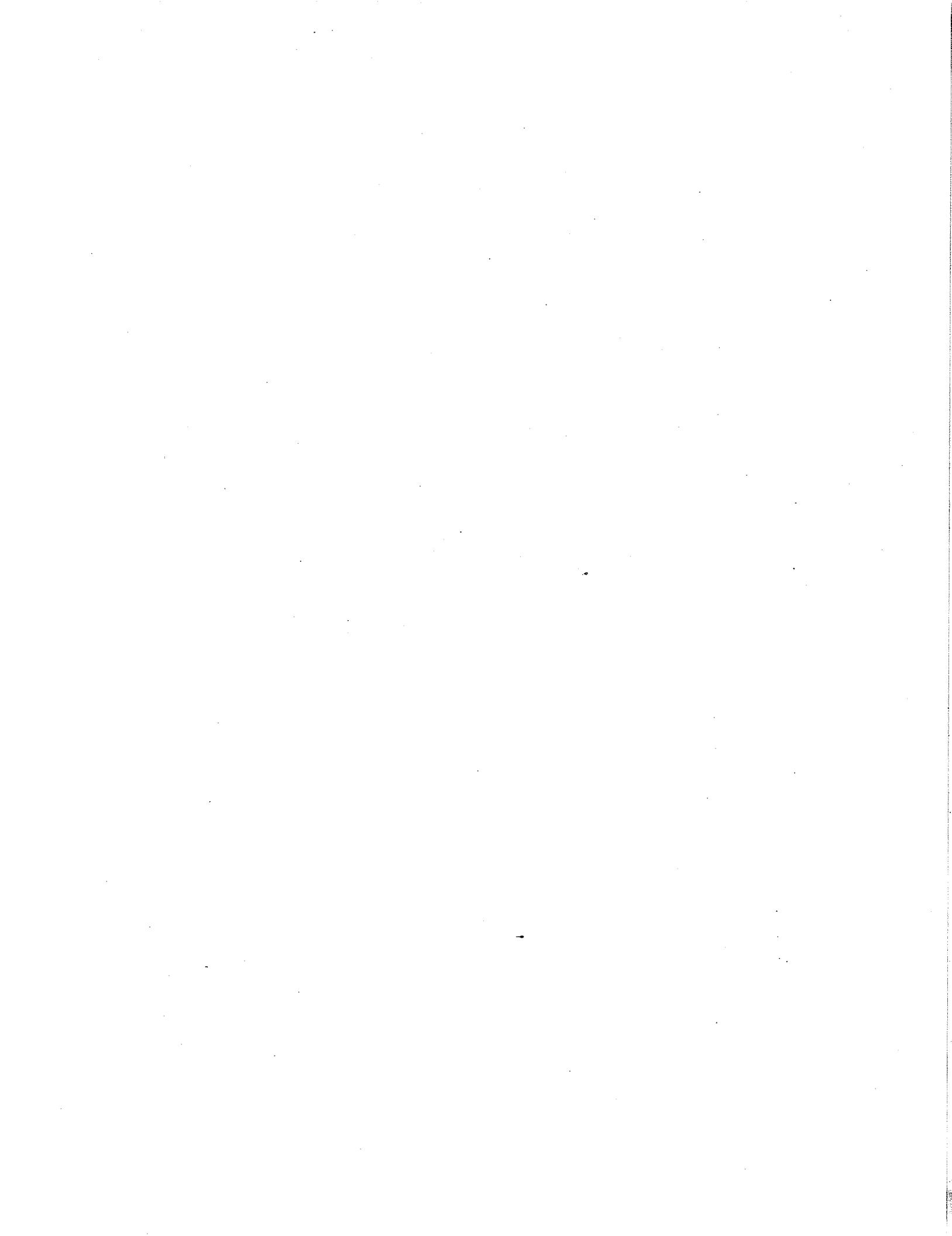
BENTHOS DIVERSITY SIMPSON'S DIVERSITY INDEX



BENTHOS RICHNESS



CHARTS



SITE S-120

	1	2	3	4	Mean
Benthos					
Richness	0	2	1	2	1.25
Simpson's Diversity	NA	0	1	0	0.33
Shannon Weiner Diversity	NA	0.693	0	0.693	0.46
Evenness	NA	1	1	1	1
Number of Dominant Taxa - Hill's N1	NA	2	1	2	1.67
Dominant Taxa % of Richness	NA	100	100	100	100
Density (# organisms/m ³)	0	88.8	88.8	88.8	66.6
Phytoplankton					
Total Richness	36	36	34	35	35.25
Simpson's Diversity	0.146	0.113	0.208	0.166	0.16
Shannon Weiner Diversity	2.281	2.441	2.099	2.082	2.23
Evenness	0.661	0.748	0.531	0.71	0.66
Number of Dominant Taxa - Hill's N1	9.79	11.48	8.16	8.02	9.36
Dominant Taxa % of Richness	54.39	63.78	48	53.47	54.91
Density (x10 ⁵ cells/L)	3.11	2.66	1.76	3.62	2.79
% Diatoms	33.6	40.9	29.6	39.2	35.83
Zooplankton					
Richness	12	13	11	NS	12
Simpson's Diversity	0.699	0.746	0.64	-	0.7
Shannon Weiner Diversity	0.762	0.588	0.85	-	0.73
Evenness	0.376	0.423	0.417	-	0.41
Number of Dominant Taxa - Hill's N1	2.14	1.8	2.34	-	2.09
Dominant Taxa % of Richness	17.83	13.85	21.27	-	17.65
Density (# organisms/L)	11.46	20.78	12.89	-	15.04
Ichthyoplankton	NONE				
Float Periphyton					
Richness	21 (6)	22 (7)	23 (6)	24 (9)	22.5
Simpson's Diversity	0.219	0.152	0.152	0.114	0.16
Shannon Weiner Diversity	1.489	1.75	1.696	2	1.73
Evenness	1.03	1.17	1.24	1.2	1.16
Number of Dominant Taxa - Hill's N1	4.43	5.75	5.45	7.43	5.77
Dominant Taxa % of Richness	21.1	26.14	23.7	30.96	25.47
Density (x10 ⁵ cells/mm ³)	7.47	8.09	5.57	3.86	6.25

SITE S-340

	1	2	3	4	Mean
Benthos					
Richness	0	0	1	1	0.50
Simpson's Diversity	NA	NA	1	1	1.00
Shannon Weiner Diversity	NA	NA	0	0	0
Evenness	NA	NA	1	1	1.00
Number of Dominant Taxa - Hill's N1	NA	NA	1	1	1.00
Dominant Taxa % of Richness	NA	NA	100	100	100
Density (# organisms/m ²)	0	0	621.6	88.8	177.60
Phytoplankton					
Total Richness	34	35	33	35	34.25
Simpson's Diversity	0.199	0.186	0.238	0.224	0.21
Shannon Weiner Diversity	2.068	2.114	1.901	1.962	2.01
Evenness	0.58	0.599	0.56	0.563	0.58
Number of Dominant Taxa - Hill's N1	7.9	8.28	6.698	7.11	7.50
Dominant Taxa % of Richness	46.47	43.58	44.65	44.44	44.79
Density (x10 ⁵ cells/L)	2.2	2.43	2.11	2.8	2.39
% Diatoms	45.3	50.7	40.4	33	42.35
Zooplankton					
Richness	11	10	10	NS	10.33
Simpson's Diversity	0.81	0.904	0.955	-	0.89
Shannon Weiner Diversity	0.497	0.261	0.146	-	0.30
Evenness	0.361	0.353	0.296	-	0.34
Number of Dominant Taxa - Hill's N1	1.64	1.29	1.15	-	1.36
Dominant Taxa % of Richness	14.91	12.90	11.50	-	13.10
Density (# organisms/L)	10.11	33.33	42.77	-	28.74
Ichthyoplankton	NONE				
Float Periphyton					
Richness	17 (6)	18 (5)	NS	NS	17.5
Simpson's Diversity	0.219	0.2	-	-	0.21
Shannon Weiner Diversity	1.48	1.47	-	-	1.48
Evenness	1.03	1.18	-	-	1.11
Number of Dominant Taxa - Hill's N1	4.43	4.36	-	-	4.40
Dominant Taxa % of Richness	26.06	24.22	-	-	25.14
Density (x10 ⁵ cells/mm ³)	8.13	6.3	-	-	7.22

SITE S-650

	1	2	3	4	Mean
Benthos					
Richness	3	2	2	3	2.50
Simpson's Diversity	0.513	0.675	0.928	0.721	0.71
Shannon Weiner Diversity	0.743	0.482	0.154	0.518	0.47
Evenness	0.858	0.776	0.461	0.569	0.67
Number of Dominant Taxa - Hill's N1	2.1	1.62	1.16	1.678	1.64
Dominant Taxa % of Richness	70	81	58	55.933	66.2
Density (# organisms/m ²)	1642.8	710.4	1243.2	888	1121.10
Phytoplankton					
Total Richness	26	25	27	NA	26.0
Simpson's Diversity	0.166	0.195	0.187	NA	0.18
Shannon Weiner Diversity	2.261	2.058	2.158	NA	2.16
Evenness	0.583	0.602	0.567	NA	0.58
Number of Dominant Taxa - Hill's N1	9.59	7.83	8.65	NA	8.69
Dominant Taxa % of Richness	47.95	48.94	45.53	NA	47.47
Density (x10 ⁴ cells/L)	3.53	2.16	3.96	NA	3.22
% Diatoms	56.5	55.3	33.7	NA	48.50
Zooplankton					
Richness	11	12	11	NS	11.33
Simpson's Diversity	0.777	0.821	0.797	-	0.80
Shannon Weiner Diversity	0.572	0.479	0.527	-	0.53
Evenness	0.369	0.353	0.365	-	0.36
Number of Dominant Taxa - Hill's N1	1.77	1.61	1.69	-	1.69
Dominant Taxa % of Richness	16.09	13.42	15.36	-	14.96
Density (# organisms/L)	10.66	10.28	17.98	-	12.97
Ichthyoplankton	NONE				
Float Periphyton					
Richness	22 (7)	22 (5)	22 (6)	NS	22.00
Simpson's Diversity	0.169	0.187	0.168	-	0.17
Shannon Weiner Diversity	1.692	1.513	1.636	-	1.61
Evenness	1.11	1.22	1.19	-	1.17
Number of Dominant Taxa - Hill's N1	5.43	5.34	5.13	-	5.30
Dominant Taxa % of Richness	24.68	24.27	23.32	-	24.09
Density (x10 ³ cells/mm ²)	8.97	5.16	6.4	-	6.84

SITE S-1000

	1	2	3	4	Mean
Benthos					
Richness	2	2	2	3	2.25
Simpson's Diversity	0.766	0.729	0.846	0.744	0.77
Shannon Weiner Diversity	1.376	0.429	0.271	0.485	0.64
Evenness	0.665	0.692	0.583	0.549	0.62
Number of Dominant Taxa - Hill's N1	1.45	1.53	1.31	1.62	1.48
Dominant Taxa % of Richness	72.5	76.5	65.5	54.0	67.1
Density (# organisms/m ²)	710.4	1154.4	577.2	976.8	854.70
Phytoplankton					
Total Richness	30	NA	32	27	29.67
Simpson's Diversity	0.188	NA	0.182	0.19	0.19
Shannon Weiner Diversity	2.029	NA	2.088	2.028	2.05
Evenness	0.65	NA	0.633	0.644	0.64
Number of Dominant Taxa - Hill's N1	7.6	NA	8.07	7.6	7.76
Dominant Taxa % of Richness	54.29	NA	53.80	44.71	50.93
Density (x10 ⁵ cells/L)	2.04	NA	2.94	3.97	2.98
% Diatoms	42.1	NA	35	65.1	47.40
Zooplankton					
Richness	13	13	15	NS	13.67
Simpson's Diversity	0.462	0.459	0.426	-	0.45
Shannon Weiner Diversity	0.878	0.915	1.06	-	0.95
Evenness	0.826	0.785	0.71	-	0.77
Number of Dominant Taxa - Hill's N1	2.4	2.49	2.89	-	2.59
Dominant Taxa % of Richness	18.46	19.15	19.27	-	18.96
Density (# organisms/L)	27.73	13.65	12.72	-	18.03
Ichthyoplankton	NONE				
Float Periphyton					
Richness	27 (6)	26 (5)	27 (6)	26 (6)	26.5
Simpson's Diversity	0.169	0.191	0.152	0.157	0.17
Shannon Weiner Diversity	1.63	1.49	1.69	1.679	1.62
Evenness	1.19	1.21	1.24	1.22	1.22
Number of Dominant Taxa - Hill's N1	5.1	4.47	5.45	5.36	5.10
Dominant Taxa % of Richness	18.89	17.19	20.19	20.62	19.22
Density (x10 ⁵ cells/mm ³)	5.22	4.94	7.1	8.13	6.35

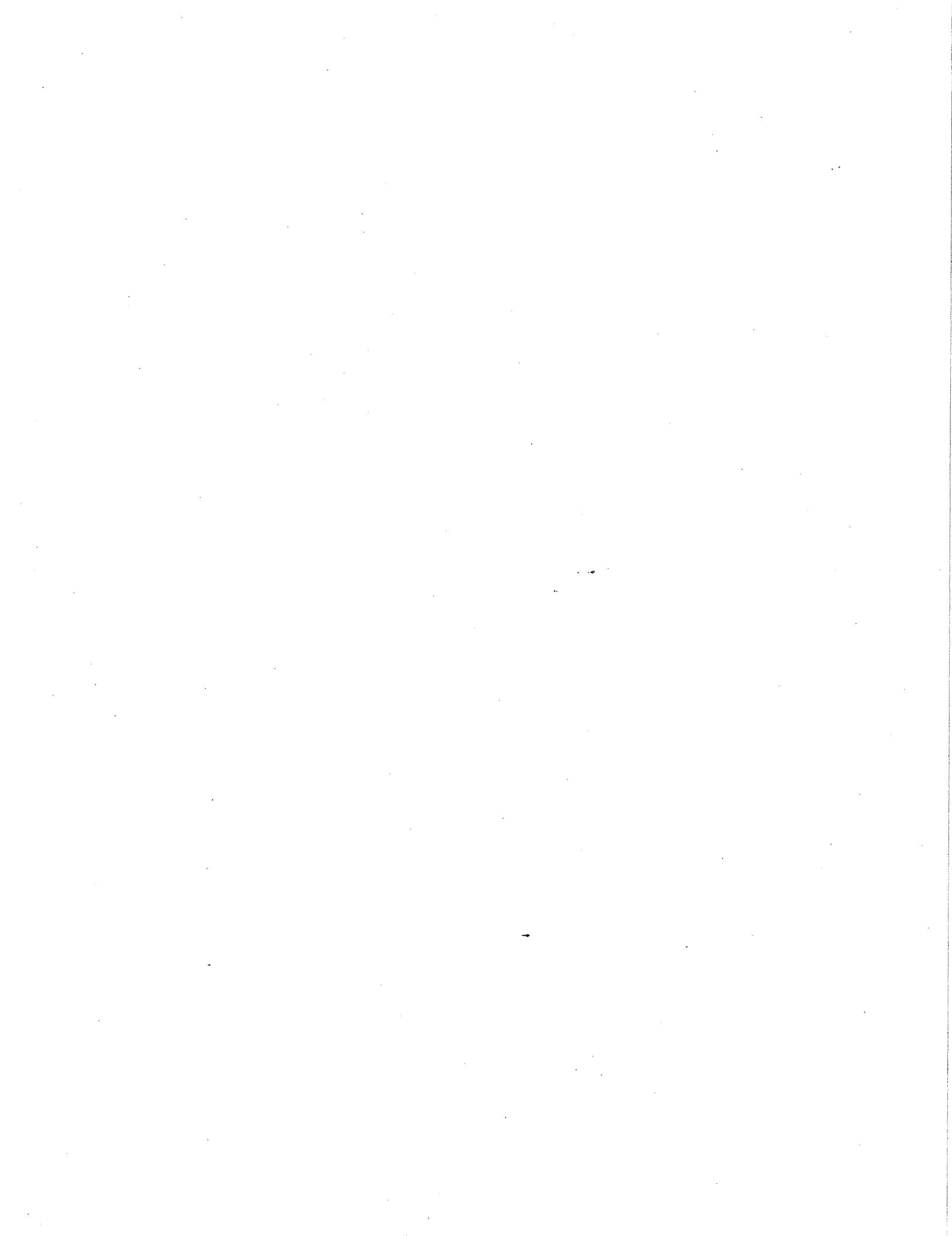
SITE S-2000

	1	2	3	4	Mean
Benthos					
Richness	2	2	2	5	2.75
Simpson's Diversity	0.909	0.864	0.815	0.364	0.74
Shannon Weiner Diversity	0.184	0.257	0.327	1.143	0.48
Evenness	0.492	0.532	0.582	0.814	0.61
Number of Dominant Taxa - Hill's N1	1.2	1.29	1.38	3.13	1.75
Dominant Taxa % of Richness	60	64.5	69	62.6	64
Density (# organisms/m ³)	976.8	2486.4	3507.6	1198.8	2042.4
Phytoplankton					
Total Richness	31	29	31	30	30.25
Simpson's Diversity	0.256	0.145	0.169	0.273	0.21
Shannon Weiner Diversity	1.822	2.234	2.162	1.869	2.02
Evenness	0.558	0.704	0.635	0.483	0.6
Number of Dominant Taxa - Hill's N1	6.18	9.34	8.69	6.48	7.67
Dominant Taxa % of Richness	36.35	46.7	45.74	40.5	42.32
Density (x10 ⁵ cells/L)	2.61	2.77	1.69	2.05	2.28
% Diatoms	24.4	56.3	40.9	32.8	38.60

SITE S-3500

	1	2	3	4	Mean
Benthos					
Richness	2	2	4	4	3
Simpson's Diversity	0.6	0.666	0.1	0.439	0.45
Shannon Weiner Diversity	0.5	0.45	1.332	0.983	0.82
Evenness	1.02	0.878	3.22	0.762	1.47
Number of Dominant Taxa - Hill's N1	1.64	1.56	3.78	2.672	2.41
Dominant Taxa % of Richness	82	78	94.5	66.8	80.3
Density (# organisms/m ²)	222	266.4	227	532.8	312.05
Phytoplankton					
Total Richness	26	26	26	24	25.5
Simpson's Diversity	0.187	0.161	0.161	0.224	0.18
Shannon Weiner Diversity	2.026	2.17	2.245	1.815	2.06
Evenness	0.657	0.669	0.615	0.671	0.65
Number of Dominant Taxa - Hill's N1	7.58	8.76	9.44	6.14	7.98
Dominant Taxa % of Richness	54.14	54.75	47.2	47.23	50.83
Density (x10 ³ cells/L)	2.97	2.32	2.44	6.44	3.54
% Diatoms	32.9	46.7	41.1	51.4	43.03

DATA



FLOAT PERIPHYTON DIATOMS⁽¹⁾

TAXA	SITES			
	S-120	S-340	S-650	S-1000
<i>Nitzschia acicularis</i> W. Smith	0.9		0.2	0.3
<i>Nitzschia delicatissima</i> Cl.				
<i>Nitzschia dissipata</i> (Kütz.) Grun.	0.7	0.7	0.9	1
<i>Nitzschia frustulum</i> (Kütz.) Grun.	1.6	0.4		0.3
<i>Nitzschia kutziniana</i> Hilse				
<i>Nitzschia linearis</i> W. Smith	1.3			0.3
<i>Nitzschia palea</i> (Kütz.) W. Smith				
<i>Nitzschia stagnorum</i> Rabh.				
<i>Pinnularia capitata</i> Ehr.				
<i>Rhoicosphenia curvata</i> (Kütz.) Grun.	0.7	0.7	0.2	0.7
<i>Stephanodiscus astraea</i> (Ehr.) Grun.	0.9	0.4	1.3	0.3
<i>Stephanodiscus astraea</i> var. <i>minutula</i> (Kütz.) Grun.				
<i>Surirella angustata</i> Kütz.				
<i>Surirella gracilis</i> (W. Smith) Rabh.		0.4		
<i>Surirella ovata</i> var. <i>pinnata</i> (W. Smith) Rabh.	0.4			
<i>Synedra acus</i> Kütz.				
<i>Synedra amphicephala</i> Kütz.				
<i>Synedra delicatissima</i> var. <i>angustissima</i> Grun.				
<i>Synedra delicatissima</i> W. Smith	0.7			0.3
<i>Synedra radians</i> Kütz.				
<i>Synedra rumpens</i> var. <i>fragilaroides</i> Grun. in V.H.				0.3
<i>Synedra ulna</i> (Nitzsch) Ehr.	0.4	0.4	0.9	0.8
<i>Tabellaria flocculosa</i> (Roth.) Kütz.				

(1) Values are relative percent abundance.

FLOAT PERIPHYTON - NON-DIATOMS (1)

TAXA	SITES										
	S-120		S-340		S-650		S-1000				
	A	B	C	D	A	B	C	A	B	C	D
Chlorophyta - Green Algae											
<i>Cladophora glomerata</i> (L.) Kuetzing											
<i>Pediastrum duplex</i> Meyen											
<i>Scenedesmus dimorphus</i> (Turp.) Kuetzing											
<i>Scenedesmus bijuga</i> (Turp.) Lagerheim											
<i>Stigeclonium subsecundum</i> Kuetzing	1	3	5	3							
<i>Ulothrix zonata</i> (Weber and Mohr) Kuetzing		3	1					1	1	1	1
<i>Ulothrix tenuissima</i> Kuetzing											
Cyanophyta - Blue-Green Algae											
<i>Oscillatoria limosa</i> (Roth.) C.A. Agardh											
<i>Schizothrix</i> sp. Kuetzing											
<i>Chrysophyta - Yellow-Green Algae</i>											
<i>Dinobryon sociale</i> Erenberg											

(1) Ranked as relative abundance to other non-diatom algae as: 5 = abundant; 3 = common; 1 = rare.

SHORE PERIPHYTON SAMPLES ⁽¹⁾

TAXA	SITES ⁽²⁾							
	A1	A2	A3	A4	W1	W2	W3	W4
Chlorophyta - Green Algae								
<i>Cladophora glomerata</i> (L.) Kuetzing	5	3	5	5	3	5	5	5
<i>Stigeoclonium subsecundum</i> Kuetzing	1	3	3	1				
<i>Ulothrix zonata</i> (Weber and Mohr) Kuetzing	3	3	3	5				
<i>Ulothrix tenuissima</i> Kuetzing		1	1					
Cyanophyta - Blue-Green Algae								
<i>Lyngbya</i> sp. Agardh				1			3	
<i>Schizothrix</i> sp. Kuetzing				1				
Rhodophyta - Red Algae								
<i>Bangia atropurpurea</i> (Roth) Ag.		1			5	3	5	3
Bacillariophyta - Diatoms								
<i>Cocconeis placentula</i> var. <i>euglyptia</i> (Ehr.) Cl.					1	3		1
<i>Cymbella prostrata</i> var. <i>auerswaldii</i> (Rabh.) Reim.	3			1				
<i>Diatoma tenue</i> Ag.		1		3			1	
<i>Diatoma vulgare</i> Bory	5	3	3	3	1	1		3
<i>Fragilaria construens</i> var. <i>venter</i> (Ehr.) Grun.						1	1	
<i>Nitzschia</i> sp. Hassall					1			
<i>Rhoicosphenia curvata</i> (Kütz.) Grun.	5	3	3	3	3	3	1	3

(1) Ranked as relative abundance to other algae as 5 = abundant; 3 = common; 1 = rare.

(2) A1 - A4 Amoco Discharge Shore Site

W1 - W4 Whihala Beach Shore Site

EPIPSAMMON PERIPHYTON DIATOMS

TAXA	SITES			
	S120	S340	S650	S1000
<i>Achnanthes exigua</i> var. <i>exigua</i> Grun.	5	2		
<i>Amphora ovalis</i> var. <i>pedieulus</i> (Kütz) V.H. ex DeT	3	2	3	2
<i>Amphora perpusilla</i> var. <i>perpusilla</i> (Grun.) Grun.			2	
<i>Caloneis bacillum</i> var. <i>bacillum</i> (Grun.) Cl.			2	
<i>Cocconeis placentula</i> var. <i>euglypta</i> (Ehr.) Cl.				1
<i>Diatoma tenue</i> var. <i>elongatum</i> Lyngb.	1		5	
<i>Diatoma vulgare</i> var. <i>vulgare</i> Bory.			1	
<i>Fragilaria pinnata</i> var. <i>pinnata</i> Ehr.	2			
<i>Fragilaria vaucheriae</i> var. <i>vaucheriae</i> (Kütz.) Peters	4	6	5	
<i>Melosira</i> sp. Agardh	1			1
<i>Navicula capitata</i> var. <i>luneburgensis</i> (Grun.) Patr.	2	13	12	11
<i>Navicula costulata</i> var. <i>costulata</i> Grun.	12	9	8	7
<i>Navicula cryocephala</i> var. <i>cryocephala</i> Kütz.	2	4	10	10
<i>Navicula exigua</i> var. <i>capitata</i> Patr.	17	10	13	13
<i>Navicula exigua</i> var. <i>exigua</i> (Greg.) Grun.	11	8	9	15
<i>Navicula pupula</i> var. <i>pupula</i> Kütz.		1		
<i>Navicula radiososa</i> var. <i>tenella</i> (Bréb.) Grun.	2	5	5	
<i>Navicula reinhardtii</i> var. <i>reinhardtsii</i> (Grun.) Grun.	1	4	5	4
<i>Navicula viridula</i> var. <i>rostellata</i> (Kütz.) Kütz.	6	4		
<i>Nitzschia linearis</i> var. <i>linearis</i> Smith				2
<i>Nitzschia dissipata</i> var. <i>dissipata</i> (Kütz.) Grun.	1			5
<i>Nitzschia fonticola</i> var. <i>fonticola</i> Grun.	-	1		
<i>Nitzschia frustulum</i> var. <i>frustulum</i> (Kütz.) Grun.	2	2	2	5
<i>Nitzschia recta</i> var. <i>recta</i> Kantz	25	25	16	24
<i>Stephanodiscus astraea</i> var. <i>astraea</i> (Ehr.) Grun.	2	1		
<i>Stephanodiscus astraea</i> var. <i>minutula</i> (Kütz.) Grun.	1	3	2	

APPENDIX B

BIOLOGICAL ASSESSMENT

COMMUNITY STRUCTURE DATA

COMMUNITY STRUCTURE STATISTICAL ANALYSES



FLOAT PERIPHYTON DIATOMS⁽¹⁾

TAXA	SITES			
	S-120	S-340	S-650	S-1000
<i>Fragilaria capucina</i> var. <i>mesoleptia</i> (Rabh.) Grunow				
<i>Fragilaria construens</i> (Ehr.) Grun.				10
<i>Fragilaria construens</i> var. <i>venter</i> (Ehr.) Grun.			0.2	
<i>Fragilaria crotonensis</i> Kitton				
<i>Fragilaria pinnata</i> Ehr.				
<i>Fragilaria vaucheriae</i> (Kütz.) Peters	4.3	0.7	5	7
<i>Gomphonema angustatum</i> (Kütz.) Rabh.				
<i>Gomphonema olivaceum</i> (Lyngb.) Kütz.	0.9	5.4	3.5	1
<i>Gomphonema parvulum</i> (Kütz.) Kütz.	0.4	0.7	1.3	
<i>Hantzschia amphioxys</i> (Ehr.) Grun.				
<i>Mastogloia smithii</i> Thwaites				
<i>Melosira islandica</i> O. Müll.				
<i>Melosira varians</i> Agardh.		0.4	0.7	1
<i>Navicula bacillum</i> Ehr.		0.7		
<i>Navicula coccineiformis</i> Greg.				0.3
<i>Navicula cryptocephala</i> Kütz.				0.3
<i>Navicula dystrophica</i> Patr.				
<i>Navicula exigua</i> (Greg.) Grun.			0.2	0.3
<i>Navicula linearis</i> Grunow				
<i>Navicula placentula</i> (Ehr.) Grun.		0.4	0.2	0.3
<i>Navicula radiosa</i> Kütz.				
<i>Navicula radiosa</i> var. <i>tenella</i> (Bréb.) Cl. et Moll.	0.4			
<i>Navicula reinhardtii</i> Grun.				
<i>Navicula reinhardtii</i> var. <i>elliptica</i> Hérib.				
<i>Navicula secura</i> Patr.			0.2	
<i>Navicula tripunctata</i> (O.F. Müll.) Bory				0.3

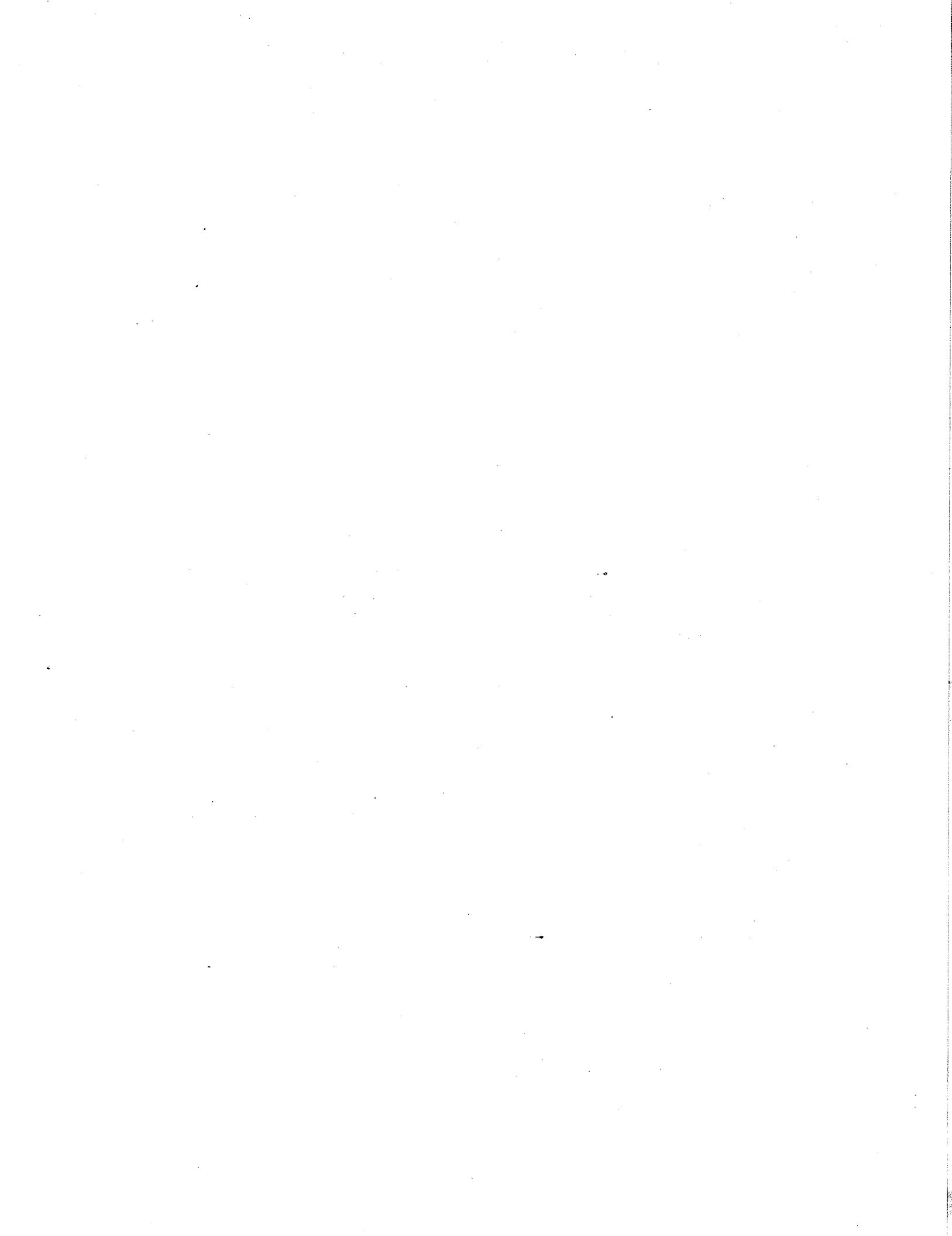
(1) Values are relative percent abundance.

FLOAT PERIPHYTON DIATOMS⁽¹⁾

TAXA	SITES			
	S-120	S-340	S-650	S-1000
<i>Achnanthes clevei</i> Grun.	0.4			
<i>Achnanthes deflexa</i> Reim.			0.7	
<i>Achnanthes exigua</i> Grun.				
<i>Achnanthes hawkiana</i> Grun.	0.4			
<i>Achnanthes minutissima</i> Kütz.	0.7		0.2	0.3
<i>Amphora calumetica</i> Thomas ex Wolle	0.4			
<i>Amphora lineata</i> Greg.				
<i>Amphora perpusilla</i> (Grun.) Grun.				
<i>Anomoeoneis serians</i> var. <i>brachysira</i> (Bréb.) Hust.				
<i>Asterionella formosa</i> Hass.				
<i>Caloneis bacillum</i> (Grun.) Cl.				
<i>Cocconeis placentula</i> Ehr.				
<i>Cocconeis placentula</i> var. <i>eugyptia</i> (Ehr.) Cl.		0.4	0.2	0.3
<i>Cocconeis placentula</i> var. <i>lineata</i> (Ehr.) V.H.				
<i>Cocconies diminuta</i> Pant.				
<i>Cyclotella bodanica</i> Eulenst.	3.3	2.5	5	4.3
<i>Cyclotella ocellata</i> Pant.				
<i>Cymatopleura angulata</i> Greville				
<i>Cymbella minuta</i> Hilse ex Rabh.		0.7	0.7	0.3
<i>Cymbella prostrata</i> var. <i>auerswaldii</i> (Rabh.) Reim.			0.2	
<i>Diatoma tenue</i> var. <i>elongatum</i> Lyngb.	71.1	77.6	64.1	54
<i>Diatoma vulgare</i> Bory	10.1	7.5		16
<i>Diatoma vulgare</i> var. <i>breve</i> Grun.			14.1	
<i>Diatoma vulgare</i> var. <i>grandis</i> (W. Smith) Grun.				
<i>Diploneis ovalis</i> (Hilse) Cleve				
<i>Fragilaria brevistriata</i> Grun.				

(1) Values are relative percent abundance.

PERIPHERYTON

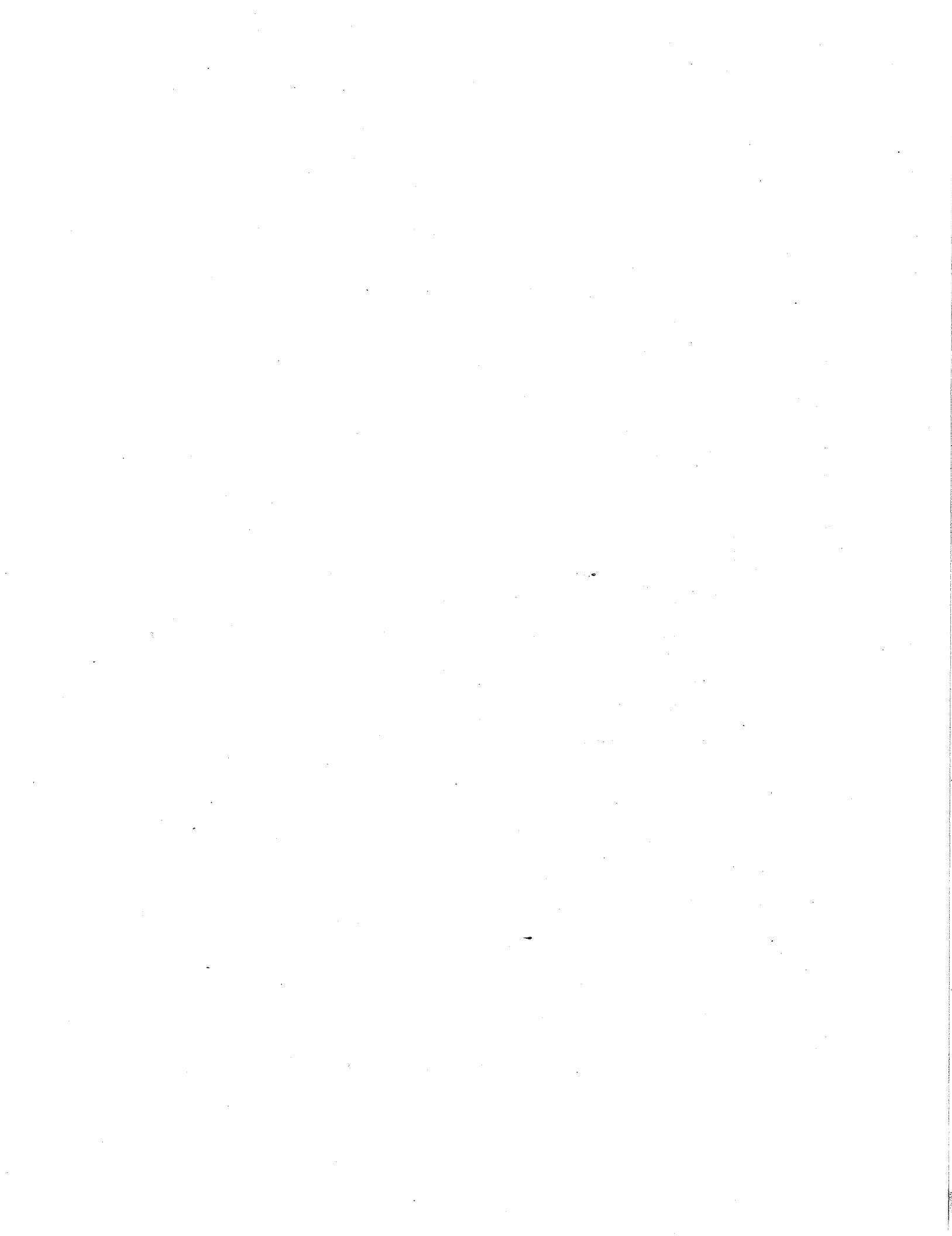


Ichthyoplankton Collections, Lake Michigan
(10-min, 1-m deep tows with 1-m diameter and 330- or 335 μm mesh plankton nets)

Collection		Fish Data				Comments
Station	Rep.	Taxa	Developmental Interval	Count	Size Range mmTL	
S-120	A	No Fish		0		1,2
	B	No Fish		0		1,2,3
	C	No Fish		0		1,2,4
S-340	A	No Fish		0		1
	B	No Fish		0		1,5,6
	C	No Fish		0		1
S-650	A	No Fish		0		1,5
	B	No Fish		0		1
	C	No Fish		0		1,6
S-1000	A	No Fish		0		1,7
	B	No Fish		0		1
	C	No Fish		0		1

Comments:

1. Macroscopic contents of sample consists predominantly of strands or clumps of filamentous algae, both live and decaying prior to preservation, and detritus (e.g., fragments of aquatic and terrestrial plant material, shells, crustacea, insects, and feathers). The only macroscopic zooplankters were several dozen copepods, probably of a single species (*Diaptomus*?). Small, translucent gelatinous masses, often with several lobes were also present (probably algae). Settled volume is less than 50 ml.
2. Sample includes a large number of fine sand particles and some small gelatinous masses assumed to be snail eggs.
3. Sample includes one or more small oligochaetes or insect larvae.
4. Sample includes one or more small snail shells and an insect pupa (dipteron).
5. Sample includes one amphipod (*Gammarus*).
6. Sample includes the chorion of a large (6 mm diameter) salmonid egg (most likely Pacific salmon, *Oncorhynchus* sp., but Atlantic salmon, *Salmo salar*, if reproducing in the lake, and *Salvelinus namaycush* sp., may be alternative possibilities).
7. Sample includes a small piece of plastic film and a small paint chip (similar man-made debris was observed but not recorded in a couple of other outer (650 or 1000) samples.



ZOOPLANKTON

TAXA	SITES (I)						SITES (II)					
	S-120			S-340			S-650			S-1000		
	A	B	C	A	B	C	A	B	C	A	B	C
Ciliaphora stalked, colonial sp		*	*	*	*	*	*	*	*	*	*	*
Rotifera bdelloid sp.	485.76	2031.3	1380.75	339	951.75	254.68	532.4	372.75	885.72	751	166.25	253.93
Cladocera												
<i>Bosmina coregoni</i>	349.14	157.99	193.31	50.85	101.52	72.77	119.79	142	137.94	90.12	59.38	193.29
<i>Daphnia</i> sp.	15.18	*	*	*	*	16.17	*	*	*	*	*	*
<i>Alona</i> sp.	*	*	*									
<i>Lepidora kindii</i>	*	*	*									
<i>Chydorus</i> sp.			*									
Copepoda												
Nauplii	9593.76	19635.9	11543.1	9110.63	31693.3	41839.9	9410.17	9336.5	16131.7	13330.3	6448.13	5889.66
Copepods, calanoids	60.72	58.68	16.57	76.28	31.73	64.68	59.9	24.85	87.12	26.29	23.75	34.11
Copepods, cyclopoids	303.6	388.2	497.07	211.88	203.04	291.06	239.58	85.2	217.8	82.61	87.88	147.81
Calanoida												
<i>Lepodiaptomus sicilis</i> (female)	24.29	13.54	42.38	12.69	16.17	13.31	17.75	7.26	3.76	14.25	22.74	
<i>Lepodiaptomus sicilis</i> (male)	7.59	33.14	8.48	9.52	*	*	*	*	*	*	*	5.69
<i>Lepodiaptomus ashlandi</i> (female)	212.52	225.7	220.92	165.26	215.73	157.66	119.79	142	159.72	52.57	99.75	113.7
<i>Lepodiaptomus ashlandi</i> (male)	121.44	90.28	96.65	93.23	88.83	64.68	46.59	35.5	43.56	12.02	40.38	70.12
<i>Limocalanus macrurus</i>			*									*
Cyclopoida												
<i>Diacyclops thomasi</i> (female)	91.08	72.22	96.65				73.21	56.09	203.28	7.51	28.5	34.11
<i>Diacyclops thomasi</i> (male)	203.41	108.34	129.79	*			34.61	72.78	116.16	33.8	26.13	66.33
<i>Eucyclops agilis</i>			*							*		*
Harpacticoida												
<i>Nitocra hibernicus</i>	*	*	27.62	8.48	*	*	16.64	*	*	*	4.75	*
Nauplii										13330.3	6449.08	5889.66

*Not seen in subsample counting but observed in general scan of uncounted residue.

(I)Values shown are estimated number of organisms per cubic meter volume.

PHYTOPLANKTON - NON-DIATOMS (1)

		SITES				SITES					
		S-1000		S-2000		S-3500		A	B	C	D
		A	C	D	A	B	C	D	A	B	C
Chlorophyta - Green Algae											
<i>Ankistrodesmus falcatus</i> (Corda) Ralfs											0.40
<i>Bulbochaete</i> sp. De Bary	37.40	37.40		45.60	12.50	34.10	13.50	37.50	32.50	34.10	
<i>Chlamydomonas</i> - palmella stage				1.00		0.70	1.00		3.10		4.10
<i>Chlamydomonas</i> sp. Ehrenberg											
<i>Protococcus</i> sp. Agardh								0.70			7.20
<i>Scenedesmus dimorphus</i> (Tulp.) Keizing											
Cyanophyta - Blue-Green Algae											
<i>Anacyclis aegagriosa</i> Kütz.											0.70
<i>Chroococcus minuta</i> (Kütz.)											
<i>Oscillatoria limnetica</i> Lemmermann											
Chrysophyta - Yellow-Green Algae											
<i>Epihydris</i> sp. (<i>ramosa?</i>) (Lauterborn) Hilliard et Asmund	7.90	8.10		10.90	18.60	12.20			13.40	12.10	12.20
<i>Mallomonas</i> sp. Perty	6.80	5.10	1.60	1.80	1.60	1.90	2.90		2.10	3.80	3.40
<i>Dinobryon sociale</i> Ehrenberg	4.70	11.30	33.40	16.30	11.10	9.50	49.30	7.70	5.00	5.20	40.90
Euglenoids - Euglenophyta											
<i>Euglena polymorpha</i> Dangeard				0.60		0.30		0.50			

(1) Values are relative percent abundance of total phytoplankton (non-diatom and diatom).

PHYTOPLANKTON - NON-DIATOMS (1)

TAXA	SITES				SITES				SITES			
	A	B	C	D	A	B	C	D	A	B	C	
Chlorophyta - Green Algae												
<i>Ankistrodesmus falcatus</i> (Corda) Ralfs												
<i>Bulbochaete</i> sp. De Bary	2.70											
<i>Chlamydomonas</i> - palmella stage	30.50	13.60	42.10	25.50	38.40	32.90	44.10	41.90	4.70	1.40	37.30	
<i>Chlamydomonas</i> sp. Ehrenberg	0.80	2.40	1.60	5.40	2.00			2.70			0.30	
<i>Protococcus</i> sp. Agardh									1.30			
<i>Scenedesmus dimorphus</i> (Turp.) Keating		0.80			1.10							
Cyanophyta - Blue-Green Algae												
<i>Anacyclis aeruginosa</i> Kütz.												
<i>Chroococcus minutus</i> (Kütz.)												
<i>Oscillatoria limnetica</i> Lemmermann					0.40				0.40			
Chrysophyta - Yellow-Green Algae												
<i>Epipyxis</i> sp. (<i>ramosa?</i>) (Lauterborn) Hilliard et Edmund	12.30	23.60	13.60	17.40	9.70	7.90	11.30	15.80				17.90
<i>Mallomonas</i> sp. Perty	4.80	4.50	6.70	4.80	2.00	2.30	2.90	3.40	1.30	3.50	4.70	
<i>Dinobryon sociale</i> Ehrenberg	14.60	11.30	6.70	6.40	2.50	4.60	1.40	3.10	35.70	39.00	5.80	
Euglenoids - Euglenophyta												
<i>Euglena polymorpha</i> Dangeard	0.80	2.80		1.40					0.30			

(1) Values are relative percent abundance of total phytoplankton (non-diatom and diatom).

PHYTOPLANKTON - DIATOMS⁽¹⁾

TAXA	SITES					
	S-120	S-340	S-650	S-1000	S-2000	S-3500
<i>Nitzschia delicatissima</i> Cl.				1.2		
<i>Nitzschia dissipata</i> (Kütz.) Grun.	4	2.2	5	5.4	3.3	1.8
<i>Nitzschia frustulum</i> (Kütz.) Grun.		1.1				
<i>Nitzschia kurtzingiana</i> Hilse						0.8
<i>Nitzschia linearis</i> W. Smith	1	1.6	8.4	2.2	4.8	2.6
<i>Nitzschia palea</i> (Kütz.) W. Smith				0.4		
<i>Nitzschia stagnorum</i> Rabh.		1.6				
<i>Pinnularia capitata</i> Ehr.		0.5				
<i>Rhoicosphenia curvata</i> (Kütz.) Grun.	2	0.5			1.1	0.4
<i>Stephanodiscus astraea</i> (Ehr.) Grun.	1.3		0.2	0.9		25.1
<i>Stephanodiscus astraea</i> var. <i>minutula</i> (Kütz.) Grun.	18.1	14.2	14.7	18	22.1	
<i>Surirella angustata</i> Kütz.	0.3	0.5	0.8		0.7	
<i>Surirella ovata</i> var. <i>pinnata</i> (W. Smith) Rabh.	1.2					
<i>Synedra acus</i> Kütz.		1.1				
<i>Synedra amphicephala</i> Kütz.			0.8			
<i>Synedra delicatissima</i> var. <i>angustissima</i> Grun.	0.3	3.9	5.1			
<i>Synedra delicatissima</i> W. Smith	3.1	2.2	4.3	7.2	2.5	2.6
<i>Synedra radians</i> Kütz.	3	3.3	2.1	1.2	1.8	1.3
<i>Synedra ulna</i> (Nitzsch) Ehr.	0.3		0.8		0.4	0.4
<i>Tabellaria flocculosa</i> (Roth.) Kütz.	0.3				0.7	

(1) Values are relative percent abundance.

PHYTOPLANKTON - DIATOMS⁽¹⁾

TAXA	SITES					
	S-120	S-340	S-650	S-1000	S-2000	S-3500
<i>Fragilaria brevistriata</i> Grun.	1.3	1.1				
<i>Fragilaria capucina</i> var. <i>mesolepta</i> (Rabh.) Grunow	30.7	33.6	24.6	33.1	26.4	38.8
<i>Fragilaria construens</i> (Ehr.) Grun.		1.1		0.4		
<i>Fragilaria crotonensis</i> Kitton		2.2				
<i>Fragilaria pinnata</i> Ehr.	0.3		0.2		0.7	
<i>Fragilaria vaucheriae</i> (Kütz.) Peters.	1.3	1.1	0.2	0.4		0.4
<i>Gomphonema angustatum</i> (Kütz.) Rabh.	0.3					
<i>Gomphonema olivaceum</i> (Lyngb.) Kütz.					1.1	
<i>Hantzschia amphioxys</i> (Erh.) Grun.		0.5	0.2			
<i>Mastogloia smithii</i> Thwaites				0.4		
<i>Melosira islandica</i> O. Müll.	0.6	0.5			0.7	
<i>Navicula cryptocephala</i> Kütz.		0.5			2.6	1.8
<i>Navicula dystrophica</i> Patr.				0.4		
<i>Navicula linearis</i> Grunow	2					
<i>Navicula radiososa</i> Kütz.				0.4		0.4
<i>Navicula radiososa</i> var. <i>tenella</i> (Bréb.) Cl. et Moll.				0.9		
<i>Navicula reinhardtii</i> Grun.		-1.6				
<i>Navicula reinhardtii</i> var. <i>elliptica</i> Hérib					0.4	0.8
<i>Navicula tripunctata</i> (O.F. Müll.) Bory	0.3	0.5		0.9	0.4	0.4
<i>Nitzschia acicularis</i> W. Smith	0.3		0.5	1.8	1.4	

(1) Values are relative percent abundance.

PHYTOPLANKTON - DIATOMS⁽¹⁾

TAXA	SITES					
	S-120	S-340	S-650	S-1000	S-2000	S-3500
<i>Achnanthes exigua</i> Grun.					1.8	
<i>Achnanthes minutissima</i> Kütz.	0.3	0.5				
<i>Amphora calumetica</i> Thomas ex Wolle					0.7	
<i>Amphora lineata</i> Greg.						0.4
<i>Amphora perpusilla</i> (Grun.) Grun.					1.4	
<i>Anomoeoneis serians</i> var. <i>brachysira</i> (Bréb.) Hust.				0.4		
<i>Asterionella formosa</i> Hass.	1	1.6	4.3	0.9	1.4	1.8
<i>Caloneis bacillum</i> (Grun.) Cl.		0.5	0.2			0.4
<i>Cocconeis placentula</i> Ehr.						0.8
<i>Cocconeis placentula</i> var. <i>lineata</i> (Ehr.) V.H.		1.1				
<i>Cocconies diminuta</i> Pant.					0.3	
<i>Cyclotella bodanica</i> Eulenst.		1.6		0.4		
<i>Cyclotella ocellata</i> Pant.	0.3					
<i>Cymatopleura angulata</i> Greville						0.4
<i>Cymbella minuta</i> Hilse	0.3					
<i>Cymbella prostrata</i> var. <i>auerswaldii</i> (Rabh.) Reim.				0.4		
<i>Diatoma tenue</i> var. <i>elongatum</i> Lyngb.	11.6	11.1	12.6	12.7	11.1	12.1
<i>Diatoma vulgare</i> Bory	13.2	8.2	10.2	7	9.1	
<i>Diatoma vulgare</i> var. <i>grandis</i> (W.Smith) Grun.	1.3		4.6	3.1	3.1	6.5
<i>Diploneis ovalis</i> (Hilse) Cleve			0.2			

(1) Values are relative percent abundance.

PLANKTON

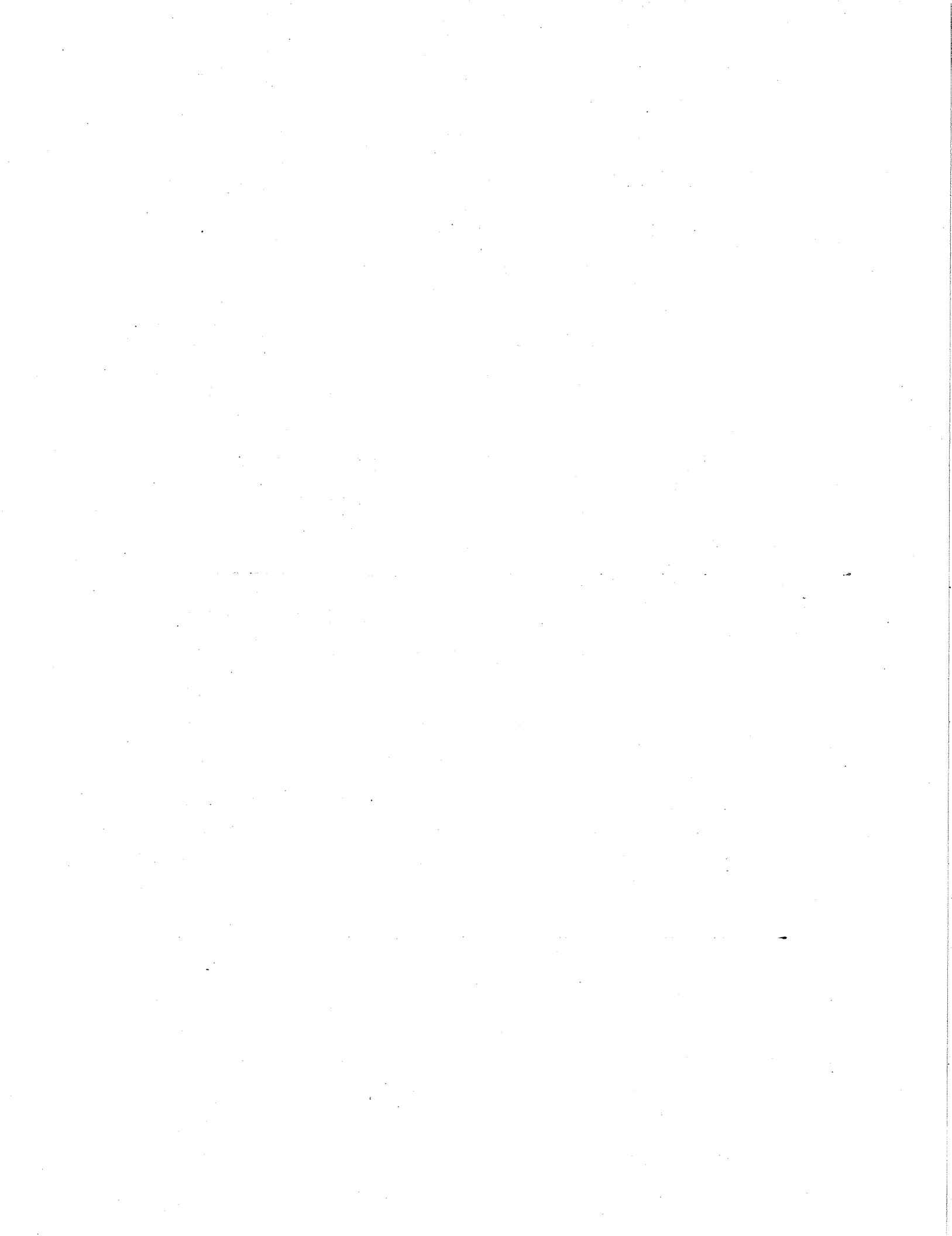


BENTHOSS⁽¹⁾

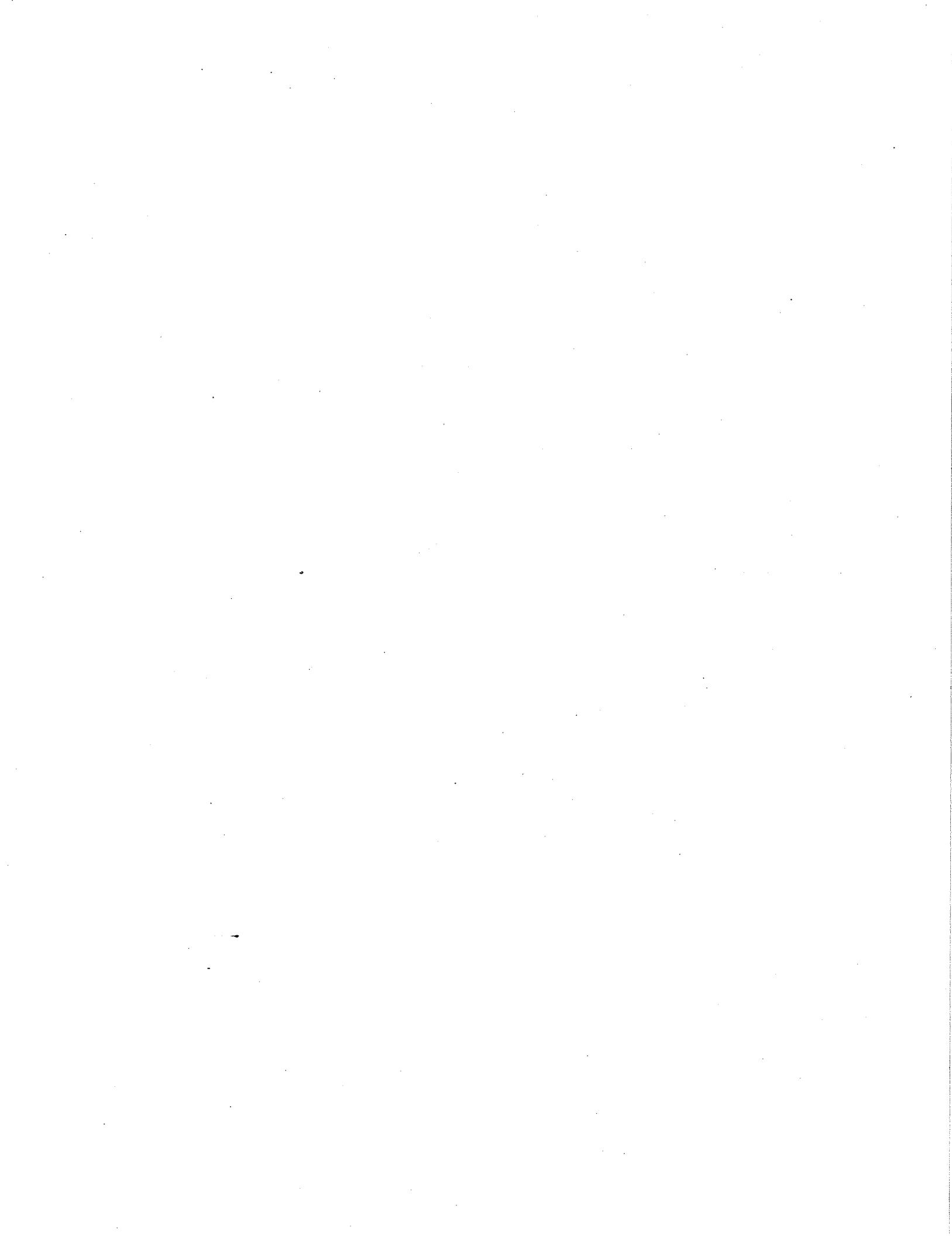
TAXA	SITES																				
	S-120			S-340			S-650			S-1000			S-2000			S-3500					
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	
Oligochaeta																					
<i>Limnodrilus</i> sp.					103.6	14.8	177.6	96.2	199.8	125.8	103.6	162.8	38.8	140.6	155.4	384.8	525.4	103.6			
Hirudinea																				7.4	
<i>Placobdella</i> sp.																					
Amphipoda																				7.4	
<i>Gammarus</i>																					
Diptera																					
<i>Cryptochironomus</i> sp.	14.8								88.8	22.2	7.4	7.4	14.8	29.6	7.4	14.8	7.4	29.6	59.2	66.6	
<i>Eukiefferiella</i> sp.									7.4		14.8		7.4			7.4			14.8	14.8	
Pelecypoda																				7.4	
Zebra mussel		7.4*																			
Gastropoda																					
		7.4*																			

* Empty shells only
(1) Number of organisms per square meter

(1) Number of organisms per square meter



BENTHOS



APPENDIX A

BIOLOGICAL ASSESSMENT

TAXONOMIC COUNT DATA



The results of the biological assessment show that the key communities in the Lake Michigan aquatic system are not adversely effected by the existing effluent discharge from the Amoco Whiting facility. Evaluations that resulted in statistically significant differences in biological community characteristics between the effluent dispersion zone and waters outside the effluent dispersion zone were attributed to harsh environmental factors unrelated to the chemical properties of the discharge. The discharge energy associated with Outfall 001 and Outfall 002 contributed to pre-existing harsh environmental conditions normal for the flooded beach zones of Lake Michigan. The turbulence, shifting and intermittent periods of substrate resuspension, and wide fluctuations in basic physico-chemical properties related to watershed inputs to the shoreline are particularly limiting to the benthic invertebrate community.

Based on the extensive biological evaluation of the Amoco Cove, there was no evidence that the Amoco effluent caused harm to the biological communities exposed to the effluent dispersion zone. Installation of a multi-port diffuser that effectively reduces the size and duration of the effluent dispersion zone can only reduce effluent exposure to biological communities. Operation of a properly designed multi-port diffuser would result in further protection of the resident aquatic biota.

copepods were very abundant at the S1000 site outside the effluent dispersion zone. The abundance of a single copepod at this site suggests a very recent hatching of this organism at the time of sampling. Copepod nauplii contributed nearly 50 percent of all the zooplankton samples from all site, and the presence of the nauplii at all sites indicates successful reproduction of the zooplankton both within, and outside the effluent dispersion zone.

- 6) The algal bioassay using *Selenastrum capricornutum* and *Scenedesmus quadricauda* showed that there was no stimulation, and no toxic effects from exposure to ambient and artificial waters representative of the effluent dispersion zone. The test species were exposed to a series of ambient Lake Michigan water and artificial treatments representing the effluent dispersion zone and receiving waters outside the dispersion zone. Statistical tests (ANOVA) shows there were no differences between treatments using chlorophyll-a, dry weight, and cell counts based on the bioassay test results. It is important to note that the test results indicate that chemical constituents of the Amoco effluent at 20:1 and 40:1 Lake Michigan water to effluent water (representing the effluent dispersion zone) had no detectable effect on the test organisms.

Significant differences in biological community structure parameters between samples collected inside the Amoco dispersion zone and samples collected outside the dispersion zone were associated with:

- naturally occurring physical restrictions or limited habitat suitability (sparse benthos community),
- artificially present due to habitats and conditions that normally do not occur (float periphyton community),
- communities that have relatively minimal exposure to the effluent compared to other physico-chemical properties (shore periphyton).

(within the dispersion zone). The statistical difference in mean benthos density within the effluent dispersion zone and outside of the dispersion zone is likely an artifact of interactions with turbulence associated with the shoreline and discharge energy in shallow waters.

Mean phytoplankton richness was significantly higher in samples from the effluent dispersion zone than from samples collected outside the dispersion zone. The total number of taxa unique to the effluent dispersion zone was 13, the majority of which were characteristic of species associated with sediments or periphyton. The increase in phytoplankton richness within the effluent dispersion zone is likely due to influx of tychoplankton, or detached periphyton cells, and re-suspended algae from the sediments. The shoreline and shallow shoreline waters are the most likely source for tychoplankton, and the proximity of the shoreline to the effluent dispersion zone accounts for the increase in richness.

Colonized periphyton collected from the sample site marker float buoys were shown to have a higher mean taxonomic richness outside the dispersion zone (mean = 24.6 taxa) than observed from collections inside the dispersion zone (mean = 20.8 taxa). The presence of periphyton on the sample site marker buoys helps illustrate that there is a lack of stable substrate available for algal colonization in the turbulent flooded beach zone. Little ecological significance to differences in richness can be attributed to algal communities during colonization.

Shore periphyton showed significantly higher measures of diversity at the Amoco Cove site than observed at the Whihala Beach collection site. Diversity, as measured by Shannon-Weiner Diversity (H'), Simpson's Diversity (λ), and Hill's number of dominant taxa (N_1), for the matted filamentous algae growth located at the waterline was higher in the vicinity of Outfall 001 (Amoco Cove) than for the matted filamentous algal growth from similar habitats located at Whihala Beach. Differences in community structure were attributed to the more developed epiphyte community associated with the *Cladophora glomerata* (Chlorophyta) and *Ulothrix zonata* (Chlorophyta) algal complex characteristic of the Amoco Cove location, and the limited epiphyte community associated with the *Cladophora glomerata* and *Bangia atropurpurea* (Rhodophyta) complex found at Whihala Beach. *Bangia atropurpurea* is commonly known to not support other algal epiphytes (Lowe *et al* 1982).

- 5) Anova procedures did not show significant differences in the zooplankton assemblages collected from within the effluent dispersion zone and outside the dispersion zone. However, review of the data indicated that the abundance of early life stage harpacticoid

The zooplankton community was less diverse than the phytoplankton community and was dominated by cyclopoid, calanoid, and harpacticoid copepods (Crustacea) at all sites. Over half the zooplankton organisms observed were early life stages (nauplii) of copepod crustaceans. The abundance of early life stage copepods shows that successful reproduction of fragile organisms occurs within the effluent dispersion zone.

Analysis of the ichthyoplankton samples either inside or outside the effluent dispersion zone resulted in no larval fish present. The lack of larval fish in the net collections is not unusual for late April collections. As explained by Dr. Darryl Snyder (Larval Fish Laboratory, Colorado State University) it was not uncommon for spawning to be delayed due to slow annual warming of the waters resulting from an extended winter or extensive winter freeze. The winter of 1993-1994 was a particularly cold winter in the midwest, and possibly contributed to a delay in spawning.

- 4) Most statistical analyses found no differences between inside and outside the effluent dispersion zone. Statistical differences in the biological collections which were identified by ANOVA procedures on descriptive community structure parameters between sites within the dispersion zone and sites inside the dispersion zone included the following:

Mean benthos richness and mean benthos density were significantly higher in samples collected outside the dispersion zone than samples collected from within the dispersion zone area. The difference is attributed to the added turbulent forces provided by the discharge energy within the effluent dispersion zone. Because of the continuous discharge, there is continuous disruption, and conceivably greater turbulence within the effluent dispersion zone than outside the dispersion zone where the discharge energy is dissipated. It is important to note that a statistical difference of only 1.2 taxa illustrates the overall lack of a benthic invertebrate community development due to unsuitable conditions.

Benthic invertebrate density was significantly higher for stations outside the effluent dispersion zone. Benthos density exhibited a wide range at all sample locations. Highest benthic organism density was observed at S2000 outside the dispersion zone and the least dense collection was at S120 within the dispersion zone. Low benthos organism density is likely confounded by increased turbulence from the discharge currents at S120, and to a lesser extent at S340